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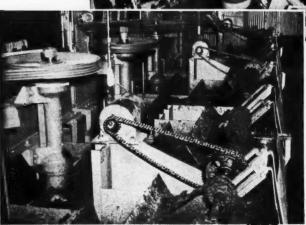




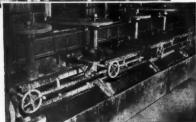


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of ALL
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plants in U.S. Use...

"Sub-A" FLOTATION







DENVER



EQUIPMENT

DENVER-DILLON Vibrating SCREENS For floor or suspension installation. "True-circle" motion. Streens in steck for quick delivery. Sixes from 1'x 3' to 6'x 14'.

DENVER Disc FILTER Extra large filter area is available in a limited space. Available with agitator in tunk. Sizes to 9'.

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timple, low-cost, dependable and accurate unit. Few moving parts, no maintenance. Standard duty 16", 21", 24" and 30" samplers and cutters in stock. DENVER
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A simple heavy-duty rake and sottling unit for the separation of solids from liquid. Sizes to 125'.

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Mining

CONGRESS JOURNAL

JANUARY, 1958

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NUMBER I

CONTENTS

FRONT COVER: Cleaning up around a stripping shovel near Harrisburg, Ill.

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ARTICLES

- 24 Open Pit Conveyors at Steep Rock Iron Mines E. H. Mulligan
- 29 Shuttle Cars from Face to Intermediate Haulage Michael M. O'Brien
- 32 What Can Research Do for Management Problems in Mining
 D. Reid Weedon, Jr.
- 35 Bulldozers and Scrapers in Anthracite Stripping Harry H. Hughes
- 41 Deepening of the Page Inclined Shaft with a Cryderman Shaft Mucker
 T. M. Tower and C. J. Ward
- 44 Fine Coal Cleaning with the Feldspar Jig Earl R. McMillan
- 49 Major Factors in Belt Conveyor Haulage Robert E. Spoerl
- 52 Kings Mountain Lithium Mining Operations Neil O. Johnson
- 62 Preventing Stream Pollution Larry Cook
- 65 Behavior of Metals Other than Uranium in Liquid-Liquid
 Extraction Processes C. J. Lewis and E. H. Crabtree

SPECIAL FEATURES

- 38 AMC Annual Business Meeting
- 57 Annual Coal Division Conference

DEPARTMENTS

- 23 Editorials
- 69 Wheels of Government
- 71 Personals
- 73 News and Views
- 85 Manufacturer's Forum

Opinions expressed by authors within these pages are their own and do not necessarily represent those of the American Mining Congress

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indexed regularly by Engineering Index, Inc.

For drifters, sinkers and stopers...

New TIMKEN® threaded bit spends less time "drilling" chips, more time drilling rock



The diagram above shows how the new Timken® threaded carbide bit spends less time "drilling" chips and more time drilling rock-gives you more hole-per-bit. That's because 1) the new Timken threaded carbide bit's newly positioned 5 front holes direct all air or water with jet-action against the rock face and 2) the deeper, wider wing clearance lets chips clear faster. And the deeper relief under the heel allows even more clearance for washedback chips. This speedier chip removal ends the problem of clogged drill steels and protects bit skirts against damage.

You save even more because new special analysis carbides in the new Timken threaded bit give it greater wear-resistance with added shockresistance. They can be reconditioned many times. The redesigned heavier wing helps drilling go faster. And the improved thread contact cuts breakage to the lowest point.

For more hole-per-bit on drifters, sinkers and stopers, use the new Timken threaded carbide bit. Write for free brochure that gives all details. The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable: "TIMROSCO".

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MULTI-USE BIT

with correct, controlled reconditioning, gives lowest cost per footof-hole when full increments of steel can be drilled.



NEW TIMKEN TAPERED SOCKET BIT

The air-leg bit of the future—here today! Removable for full steel life. Tapered for more secure union. Same new frontal features as threaded bit.

REMOVABLE

TIMKEN

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ROCK BITS



How Owl Truck & Construction Co.

produces 7,000 tons of granite road-base daily

Owl Truck & Construction Co., Alameda, California, produces 7,000 tons of crushed, decomposed granite rock daily, at their San Gabriel, Calif. pit. Material is used for roadbase under concrete or asphalt.

To achieve required production, the company tried two crawler-tractors for short-haul dozing of material to crushers. This method was found to be slow and expensive. Due to loose abrasive rock, crawler's tracks had to be replaced every 1000 hours. Owl Truck then purchased 2 modern Le-Tourneau-Westinghouse rubbertired Tournatractors® to handle this phase of the job.

Here's how these rubber-tired tractors helped speed production:

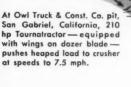
512' dozing cycle in 1 min. 46 sec.

First, the decomposed granite rock is loosened. Then Tournatractors — traveling in 3rd gear (7.5 mph) —

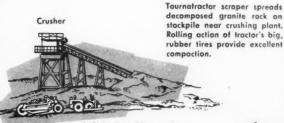
doze heaped load 256' down 12-15% grade to crusher in 43 seconds. Tractors then back up same distance in high gear (7.2 mph) in 1 minute 3 seconds... completing 512' cycle in 1 min. 46 sec. Fast dozing cycles like this helped boost production.

Tows scraper on long hauls

To move material long distances, one of the tractors occasionally tows an old L-W Carryall Scraper. With speedy Tournatractor used as primemover, scraper self-loads 8 yds. in 37 seconds over 125'. Unit then hauls 160' down 8% grade in 23 seconds ... and spreads material on stockpile in 13 sec. (Stockpiled material is dozed to crusher by rubber-tired tractor when needed.) Tractorscraper returns 334' to load area in 48 sec.... completes a 695' cycle every 2 min. 1 sec. The one-man Tournatractor-scraper combination averaged 24 loads or 192 yds. per hour.



Dozes 256' in 43 seconds





"Low maintenance costs, increased production"

Crusher

Pleased with Tournatractor's performance, Pit Superintendent Walter C. Butler said, "This tractor definitely has a place in pits and quarries. The low maintenance costs and increased production show up well on the balance sheet." The operators were also enthusiastic about these rubber-tired tractors. Emery F. Dolson, Jr. says, "There's a lot less wear and tear on me when operating Tournatractor instead of a crawler."

Compare Tournatractor with present dozers

Why not ask for a demonstration? Compare this high-speed, go-anywhere rubber-tired tractor with your present dozers. See how you, too, can increase pit production and cut operating costs. Call or write for full details.



LETOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company,

AN IMPORTANT MESSAGE



TO USERS OF EXPLOSIVES

American
Cyanamid Explosives
Now Serve You
Nationwide
and
Market-Wide!

In a move to extend and broaden the range of our services to explosives users, American Cyanamid Company has purchased the plants, magazines and sales facilities of Illinois Powder Manufacturing Company.

Because of these expanded facilities, it is now possible for Cyanamid to serve you better...faster...with a wider range of dependable, quality explosives, electric blasting caps and blasting accessories.

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Blosting Caps
Electric Blosting Caps
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Blosting Accessories



ROAD



QUARRYING



METAL



COAL



OIL EXPLORATIONS



At a large open-pit mine in Arizona, ore is mined at low levels and hauled by railroad cars... at higher levels, overburden is removed by a fleet of 35-ton trucks. To help these haulers travel at safe, profitable speeds, and to speed road and railspur construction—the mine uses two 150 hp Adams* 660 graders.

Patrols roads 24 hrs. a day, 6 days per week

One of the heavy-duty "660" Le-Tourneau-Westinghouse units is used primarily for maintaining many miles of haul roads. This fast-moving grader patrols these busy mine roads 24 hours a day, 6 days a week. It goes wherever needed... to fill ruts, level washboard, clear debris dropped by overloaded haulers and improve drainage.

For working along steep drop-offs, the Adams' standard blade extends a full 7½ ft. beyond wheel line, to give operator safe working margin. Extra-safe dual-braking system stops transmission as well as tandem drive-wheels for sure, safe stops and minimum brake wear.

Helps build new roads, RR grades

The second "660" grader—equipped with bulldozer blade—is used on new construction work and for maintaining waste dump. When constructing new roads or railroad beds, the "660" handles all the blade work.

Works any kind of material

Wide range of speeds give Adams advantage for working efficiently in any kind of material. All 80 to 150 hp Adams graders have an 8 forward and 4 reverse speed transmission. In addition, optional 3-speed "creeper" gears (0.23 to 1.82 mph) may be added. These low, full-

power speeds move heavier loads, handle rocky material with greater speed and safety, insure more accurate blade control for fine finishing around forms or obstructions.

Adams' largest grader — the powerful 190 hp POWER-Flow 660, with torque converter — gives you an infinite number of speeds forward to 27.4 mph... reverse to 24.4 mph. Adams' smallest, the 60 hp "220", has 5 speeds forward to 18.3 mph — best in its class.

See Adams in action

Why not see how you, too, can step up mine and quarry production, cut operating costs — with heavy-duty Adams graders? There are 6 models: 190, 150, 123, 115, 80, 60 hp. Choice of GM or Cummins engines on 5 larger models. Call or write for a demonstration at your pit.



With dozer blade, "660" maintains waste dump. Over 72% of the total amount of material mined at this copper mine is waste.

Powerful "660" helps build exploration roads and RR road beds fast and easy. Commenting on the Adams grader, the second operator said, "I like the power and weight of the '660'. Also, the big 14-ft. moldboard and wide choice of speeds."



*Trademark G-1483-M-1



LETOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

THE SPLICE OF LIFE

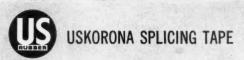
When you splice and reinsulate with Uskorona® and re-jacket with "D.R." splicing compound, you renew the life of the cable. The entire splice will last as long as the cable.

These entirely reliable tapes are:

- Extra-tight gripping, plus high in tensile strength.
- Resistant to acid, alkalies and moisture ...ideal for use on mining machine cables.
- Impossible to pinhole, so dangerous leaks can't occur.
- Absolutely waterproof.

Uskorona exceeds A.S.T.M. specifications and can handle a wide range of electrical and general purpose jobs in mines. A complete line of mine tapes is available at any of the 28 "U.S." District Sales Offices, at selected distributors, or write us at Rockefeller Center, New York 20, N. Y. In Canada, Dominion Rubber Co., Ltd.







ABOVE GROUND. When spliced with Uskorona and "D.R." tapes, cables become perfect again. These splices restore the mechanical and dielectric quality of the cable, resist severe abrasion and exposure to moisture.



BELOW GROUND. Being run over by cable cars in coal mine can't hurt Uskorona splices protected by "D.R." splicing compound. They take this punishment many times a day.



Mechanical Goods Division

United States Rubber



2. Point-of-action

electric motors

1. Fingertip

electric controls

- 3. Hinged body design ... no frame, no springs
- Big, multi-disc air brakes on all 4 wheels...selective brake control locks front or back wheels, or both

- Wide bowl, with low rear entry, makes loading easier, faster
 with less spillage
- All-steel body . . . with tri-level bottom
- Interchangeable tires and wheels, front and rear

Cut your pit costs

with high-production Tournapull® Rear-Dump haulers

Capable of high-production in all materials, with a minimum of maintenance, LeTourneau-Westinghouse Tournapulls with Rear-Dumps give you more for your money in productive hours worked... more in tons moved... at lower cost. Here's why!

Simplified construction

Rear-Dump construction is radically simplified from that of conventional haulers. In place of a foundation frame and body sub-frame, Tournapull prime-mover and trail unit are hitched together by means of a rugged, high, horizontal yoke. Yoke pivots horizontally on kingpin at front...then extends back along the sides of the bowl, where it is pivoted vertically just above and ahead of rear wheels.

Heavy-duty bowl resists shock, abrasion, and crushing damage of big chunk-rock dropped by excavator.

Big tires

There are no dual tire or mixed size problems. Big, single, low-pressure tires adequately absorb the shocks of rough off-road travel and shovel loading. Troublesome springs, spring hangers and tie-rods that require frequent maintenance and replacement are eliminated. Long-wearing tires are interchangeable all around...one spare serves an entire fleet.

2-wheel prime-mover

Front-wheel drive and kingpin-type steer further simplify Tournapull construction. A multitude of trouble-causing parts are eliminated. No longer must power be carried back to the rear through a long drive-shaft...with its inherent bearing, universal joint, and lubricating problems. No longer is steering handled by small front wheels subject to misalignment from "bulldozing", as they try to get out of ruts. All com-

pact machinery inside prime-mover case is readily accessible for quick adjustment, easy servicing.

Simple, safe dump action

A touch of electric switch on dashboard instantly activates point-ofaction body-hoist motor. Entire dump is under power control there is no free fall. There's no delay for hydraulic pressure build-up, no shock-loads—as with gravity dumping. You save on maintenance time, too, because there is no hoist maintenance to check...only a few places to inspect and lubricate.

For complete information

Find out how these savings can put money in your pocket. There are three LeTourneau-Westinghouse Rear-Dump sizes to fit your requirements, with 11, 22 and 35-ton capacities. Write for information.

R-1409-M-1



LETOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

"Not merely to sell; but to serve...not only to make good steel products; but to make them still better...not only to fulfill today's requirements; but to anticipate tomorrow's—these are the principles that constantly guide CF&I."

G. F. Frang President



We've taken our own advice

When any business is "soft", management often uses this period to clean house. All operating methods are examined carefully with an eye toward increasing efficiency by revising or eliminating those practices that hamper productivity—practices that could not be corrected during peak periods.

In the past, there have been times when the demand for CF&I Grinding Balls has exceeded our capacity, and you have had to wait for deliveries. More recently, demand has been off somewhat, and we have utilized this period to improve our own production efficiency, and new equipment has been added to increase our volume. Now we are in a position, when the demand again picks up, to offer you greater production and quicker deliveries from our enlarged stocks of grinding balls. Thus, we have "anticipated tomorrow's requirements"—we have taken our own advice.

We feel sure that most grinding mill operators follow these procedures—that they do make a drive toward increased efficiency during slack periods, so that they will be all the more prepared for periods of intensive output. To help you do

this, CF&I has instituted this two-pronged service program:

- Engineering Service ... CF&l's Mining Products Engineers are ready to analyze your grinding mill problems; make recommendations on how you can improve your operations.
- Technical Information... CF&I is currently preparing a series of advertisements containing technical information on ways to improve grinding mill operations.

Take advantage of our Engineering Service and look for the ad series in this publication...they'll be appearing regularly during 1958 and reprints will be available. The nearest CF&I sales office will be glad to service your needs.

Other CF&I Steel Products for the Mining Industry

CF&I Grinding Rods • CF&I Rock Bolts • Wickwire Rope
CF&I Mine Rails and Accessories • CF&I Industrial Screens
Realock Fence and Fabric • Grader Blades and other
Cutting Edges



FORGED STEEL GRINDING BALLS THE COLORADO FUEL AND IRON CORPORATION

Albuquerque * Amarillo * Atlanta * Billings * Boise * Boston * Buffalo * Butte * Casper * Chicago * Denver * Detroit * El Poso * Ft. Worth * Grand Junction Houston * Kansas City * Lincoln (Neb.) * Los Angeles * New Orleans * New York * Oakland * Oklahoma City * Philadelphia * Phoenix * Portland * Pueblo Salt Lake City * San Antonio * San Francisco * San Leandro * Seattle * Spokane * Wichita

5662

National Mine Service Company

New Convenience and Economy for users of



"Redbird" Conveyor Chain

Clarkson "Redbird" Conveyor Chain, standard of the industry for economy and durability, is now stocked and distributed in all major coal fields by National Mine Service Company. The regularly scheduled truck deliveries which established the National Mine reputation for service will now bring you Redbird chain—already assembled in lengths for convenient handling.

To gain maximum strength and balanced construction, Clarkson Redbird flights and flight

pins are welded together—forming an integral unit. This type of construction also facilitates replacement, since it is necessary only to break the cottered chain and insert the new flight assembly. Longer chain life, reduced downtime, less adjustment and fewer replacements make Redbird the most economical chain available.

Your National Mine representative will be glad to show you how Clarkson Redbird can reduce your chain costs.

*Clarkson Manufacturing Co., now Clarkson Division of National Mine Service Company,

National Mine Service Company

564 Alcoa Building . Pittsburgh 19, Pennsylvania

All-State Division Logan, W. Va. Anthracite Division Forty Fort, Pa. Ashland Division Ashland, Ky. Bemeco Division Beckley, W. Va.

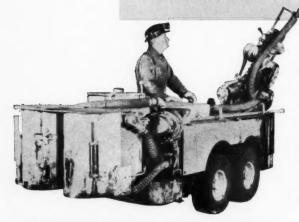
Clarkson Division Nashville, III.

Kentucky-Virginia Division Jenkins, Ky.

Western Kentucky Division Madisonville, Ky. Whiteman Division Indiana, Pa. Mountaineer Division Morgantown, W. Va.

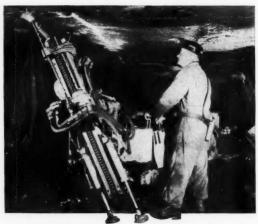
JOY RBD-15

ROTARY ROOF BOLTING DRILL FOR SHALE, SLATE, OR SANDSTONE ROOF

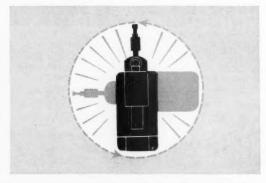


The Joy RBD-15 is a hydraulic rotary drill designed to bottom holes in 65% of all U. S. coal mines in often half the time required by pneumatic or electric drills. A central hydraulic system coupled directly to a 15 hp electric motor powers tramming, steering, drill rotation, drill feed and boom roll.

The RBD-15 operates in seams from 42" to 96" high. One basic frame and chassis is offered in two heights; the 33" model for low and medium-low seams, and the 37" model for high seams, or for medium seams requiring high ground clearance.



Simple controls, centralized at the operator's station, provide instant control of thrust, feed-speed and torque and drilling angle. Drills, runs steel and sets bolt without gear shifting.



HIGHLY MANEUVERABLE

The RBD-15 is fast and flexible ... trams up to 108 fpm. Individually controlled pairs of wheels on each side can be powered independently ... forward on one side—reverse on the other ... the machine turns in its own length (dimensions 33" x 42" x 9' 6") like a crawler mounted unit.

TWIN BOOM MODEL

The RBD-11 has twin booms with RDU-1 drill units. Each boom swings 90° out and 25° in to provide a 23 foot face drilling range...has 240° roll and 30° tilt... can be individually controlled. The RBD-11 is an all-hydraulic machine, 43" high, 82" wide and 22' long, equipped with a 26 hp electric motor, and a four section hydraulic pump. The RBD-8 is a single boom version of the RBD-11, available with either electric or diesel power.

diesel power.

The RBD-7 is an unmounted boom and drill unit to be mounted on a mine car or shuttle car.



DRILLS AT ANY ANGLE GETS IN ANYWHERE

(TURNS IN ITS OWN LENGTH)



Boom Tilt

Boom Roll

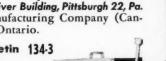


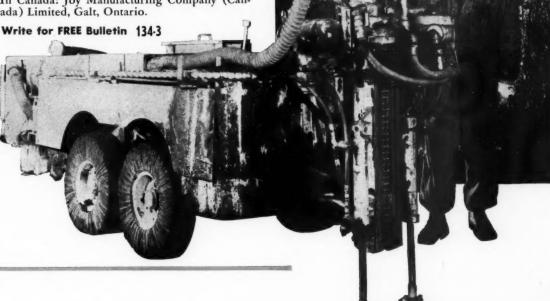
The two sketches at upper right illustrate the action of the hydraulic boom roll and the easy manual tilt that makes it possible for the RBD-15 to drill at any angle. The boom roll also allows the operator to change steel without moving the machine. The drill unit consists of a two-speed rotation unit, a two-speed feed unit, steel centralizer and two foot jacks . . . all mounted on a rigid feed frame.

Two hydraulic rotation motors allow the operator to choose rotation speed and torque ... 650 rpm for high speed drilling . . . low speed up to 360 rpm with torque up to 240 ft. lbs. for tighten-

ing bolts or harder drilling.

Feed thrusts can be varied up to 5500 psi...
feed speeds up to 12 fpm, with "run-up" and retraction speeds up to 60 fpm. Write Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa. In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario.





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W CL 8347A-134

CONTINUOUS MINERS MOBILE LOADERS SHUTTLE CARS COAL CUTTERS, CUTTING MACHINE TRUCKS, COAL DRILLS, CONVEYORS, TIMBER SETTERS. SHUTTLE CAR ELEVATORS, BELT FEEDERS, FANS, BITS, PORTABLE BLOWERS, COMPRESSORS ROCK DRILLS, HOISTS, CORE DRILLS



NOTHING TRANSMITS POWER WITH THE FLEXIBILITY OF ROEBLING

ROYAL BLUE WIRE ROPE. This, and its exceptional resistance to abrasion, shock and corrosion attack, make Royal Blue the strongest and safest wire rope you've ever used. On any comparative cost basis, nothing matches it as an instrument for transmitting power. For details on the real meaning of long service life, contact your nearby Roebling Distributor, or write Wire Rope Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.



DESIGN
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Its ready adaptability is evident wherever power is transmitted. It conforms to unique design requirements Use wire rope to transmit power.

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Reinforced overhang prevents break-offs.

Grey iron centers keep mounting cost down, lower stress concentration.

Quick delivery!
Minimum inventory!

No tread splitting, because curved plates support the tread at load center.

> Chilled tread is harder, lasts years longer without wear.

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for cost-conscious operators!

In mine after mine, **QCf** Load-Support Chilled Tread Mine Car Wheels give millions of ton-miles of low-maintenance service! Extra quality in every feature gives longer service in every use, minimizes haulage delays for wheel repairs, lowers mine car wheel inventory requirements. Ask your American Car and Foundry representative for facts and figures! AMERICAN CAR AND FOUNDRY, Division of **QCf** Industries, Incorporated, 30 Church Street, New York 8, N. Y. Sales Offices: New York—Chicago—St. Louis—Cleveland—Washington, D. C.—Philadelphia—San Francisco—Berwick, Pa.—Huntington, W. Va.—St. Louis, Mo.

acf

AMERICAN CAR AND FOUNDRY

DIVISION OF ACF INDUSTRIES, INCORPORATED

LOAD SUPPORT MINE CAR WHEELS



... They've shortened the cycle with

O-B Expansion Shells and Plugs!

Bolting crews spend less time installing and wrenching bolts — have more time for drilling holes — when they use O-B expansion Shells and Plugs!

That's because O-B Shells and Plugs "go up easy and stay put" in any kind of top material. Bolt assemblies "go up easy" because the O-B shell flexes to overcome variations in hole diameter. They "stay put" even before wrenching because the weight of the assembly alone is enough to start expansion of the shell, and because the shell makes a firm contact with the sides of the hole.

This speedy installation leaves more time for drilling — means faster bolting, less exposure to unsupported roof, and an added measure of safety for bolting crew and all production workers.

Next time, order O-B Shells and Plugs!

4812-M

Okio Brass MANSFIELD OHIO, U. S. A.

IN CANADA CANADIAN OHIO BRASS CO LTD NIAGARA FALLS ONT

On the scene with the "RIVERQUEEN"

New Bucyrus-Erie 1650-B Stripping Shovel



TOWER OF STRENGTH! Sturdy front end of the River Queen rises high above the pit to a height of 140 feet from the ground to the top of the boom sheave.

This new 1650-B stripper is removing overburden, including a 10-ft. ledge of limerock, from two seams of coal at the River Queen Coal Company mine near Central City, Ky. Equipped with a 145-ft. boom, 86-ft. handle and 55-cu. yd. dipper, it has a dumping reach of 147½ feet and a working range of over 300 feet.

Unique flexibility makes it possible to equip the 1650-B with the most suitable digging combination for a specific need. It is designed and built to handle dipper capacities from 40 to 65 yards, depending on the choice of boom and handle lengths. Dumping reach varies accordingly from 178 to 135 feet.

Here is quality in action — another example of stripping shovel performance in the finest Bucyrus-Erie tradition — combining unique flexibility with range, capacity, speed, and reliability to provide consistently high output at low operating cost. For further information, write us direct.

BUCYRUS-ERIE COMPANY

South Milwaukee, Wisconsin

*Owned jointly by W. G. Duncan Coal Co. and Peabody Coal Co., and operated by Peabody.



BOARDING-HOUSE REACH! The River Queen piles earth and rock nearly 300 feet away from the digging point and stacks it more than 100 feet high.



but with more than 80 tons of rock and earth in each cycle, the River Queen can pile up a "mountain" of more than 100,000 tons in a 24-hr. period.



WHAT AN APPETITE! 55 cubic yards per bite for the River Queen. Flexibility of boom and handle lengths permits the 1650-B to be equipped for 40- to 65-cu. yd. service.



ime is



with the

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Take a real good look at these LEE-MORSE "TIME-SAVERS"! Like modern misers they hourd minutes into extra productive hours by cutting portal to portal time—reducing costs—increasing tannage output.



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(Locomotive Type)

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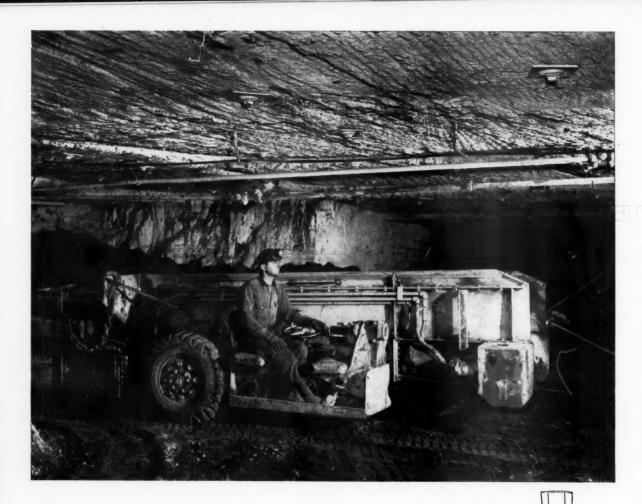
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EDITORIALS

ROBERT W. VAN EVERA, Editor

JANUARY, 1958

HOW MUCH TECHNICAL EDUCATION

REPORTS on Russia's success in training scientists and technical personnel are the source of considerable apprehension to American educators, statesmen and industrialists. The Reds have conceived, and put into practice, a determined plan to accelerate production of engineers and competent scientists. And they are getting results—by methods wholly inconsistent with this country's concept of good education. Maybe we can learn something from the Russians; maybe we can't.

Illiteracy has been virtually eliminated in Russia—as it has here—and they have about the same proportion of their population in schools as we do. But beyond this there is little similarity in the two systems of education. Indeed the Russian graduate is not an educated person by our standards, but, nonetheless, he is prepared to go into industry in an important technical position and start right in to produce. The average American graduate, by contrast, is not ready to produce on the first day of his first job.

Whereas in this country only 25 percent of our college graduates go into engineering and scientific fields, in Russia fully 60 percent of the graduates are directed—by dictate of the State—into the technical work of the Soviet economy. There, the "educated" man has received a concentrated training along narrow lines of endeavor and has penetrated his field to far greater depths during his school days than his American counterpart. Our educational standards have long indicated a need for broader training of engineers.

Has America overstressed the cultural side of education? We do not think so, but it is worth considering whether we have failed, somewhere in our educational system, to provide intensive training to those among our students who are equipped to receive it and are not receptive to the broad, cultural schooling that is available. We must decide whether we can learn anything from the Russians in this respect or not.

Engineering school administrators will agree that most high school graduates in this country are not well versed in science, mathematics and other basic theory. The Russians—and for that matter most European educators—have proved that it is possible to give school children much more along these lines than our schools are doing.

The matter of better technical education in this country warrants serious study. An adequate force of technical brain power is a potent weapon for waging the cold war and an absolute "must" in case of space warfare—a weapon that could well tip the balance in Russia's favor.

METALLURGICAL CHANGES IN IRON ORE

THE December issue of MINING CONGRESS JOURNAL carried an article on the direct reduction of iron ore, written by H. S. Turner, Vice-President of Research and Development of Jones & Laughlin Steel Corp. We feel that every mining man should read this article—not to become an expert on direct reduction, but to acquire a nodding acquaintance with what may well become part of a long term revolution in the steel industry. The wheels of progress turn slowly, but Dr. Turner's article would indicate that they also turn surely.

The Lake Superior taconite operations have succeeded in turning out concentrate pellets that are enthusiastically received at the blast furnace. These pellets are not iron ore in the conventional sense. They are in fact a specially processed feed material for blast furnaces. As a sidelight in the taconite picture, the gossip has it that during experimental work in pellet sintering, iron range metallurgists found, during a period of difficulty in controlling the sintering furnace, that they were actually reducing iron oxide to pig iron.

More recently publicity has been given to the Halverson process, which reportedly opens up, for possible development, vast deposits with high iron content but which have hitherto been uneconomic due to the presence of titanium. The key to the process is in the introduction of sodium chloride as a flux in the reducing furnace.

How significant are these innovations? Within a decade or two we should know whether we are now witnessing the beginnings of a metallurgical revolution in the iron and steel industry.

OPEN PIT CONVEYORS

AT

STEEP ROCK IRON MINES

The iron ore deposits of Steep Rock Iron Range lie at the bottom of a former deep lake basin. Rugged terrain coupled with the instability of the lake bottom clay made it necessary to locate all road and rail facilities on the rim of the basin. To move ore from open pit mines located in the bottom of the steep walled basin to loading facilities located on the rim, a fairly extensive system of pit conveyors has been constructed. Conveying 1000 gross tons per hour, these conveyors have moved about 10 million tons of iron ore through rugged terrain at a cost of about four cents per ton

By E. H. MULLIGAN

Assistant Chief Engineer General Engineering Div. Steep Rock Iron Mines, Ltd.

THE Steep Rock Iron Range is sit-uated in northwestern Ontario, 140 miles west of the Canadian Lakehead and 60 miles north from the International Boundary. At the present time Steep Rock Iron Mines is the only producer in the field, but the Caland Ore Co. is engaged in readying their lease for production in early 1960. During the period, 1945 to the present date, this region has shipped 18 million tons of high grade iron ore to the Lower Lakes ore markets. The combined operations of Steep Rock and Caland are scheduled for an annual production of 81/2 million tons by the year 1962.

The iron ore deposits of the Steep Rock Iron Range lie in the basin of the former Steep Rock Lake. To reach the orebody outcrop, it was necessary to divert a major drainage system, pump some 120 billion gal of water from the lake basin and remove a bed of varved clay which overlaid the orebodies, in depths of up to 200 ft.

This accomplished, the company was faced with the problem of operating open pit mines in the bottom of a steep walled basin. The rugged terrain coupled with the instability of

the lake bottom clay dictated that all main roads and rail facilities be located around the rim of the basin.

The initial open pit, the Errington, was located in a high area of the lake bottom where the vertical lift and haul distance to the loading terminal and rail facilities was not too great. This pit was mined as an all truck haulage operation. The operation produced in excess of 9 million tons of ore prior to being converted to underground methods.

Experience gained during the operation of the Errington open pit made it obvious that the transportation of iron ore from the open pit to the loading terminal merited particular attention when the plans for mining the deeper, more distant orebodies were formulated.

The railway facilities to serve these pits were fixed in position by topography. This, in turn, allowed for little freedom in the choice of sites for the loading terminals. The terrain intervening between the pits and loading terminals was very rugged and broken. Therefore, the problem to be resolved was the movement of a large tonnage of iron ore over a horizontal distance of approximately one mile and through a vertical distance of 725 ft, at a uniform rate and at the most favorable cost per ton. A complicating factor was that 300 ft of the total vertical lift occurs in a distance of 1000 ft at the rim of the basin.

A thorough study of materials handling methods was undertaken, with special attention to the methods in use on the Mesabi Range. Our investigations disclosed that:

- (a) Conveyors were possibly the best bulk haulage medium for short to medium distance hauls, particularly through adverse topography.
- (b) The capital outlay for conveyors was quite low when written-off against total tons moved. At Steep Rock, this figure will be about \$0.023 per ton.
- (c) The operating cost is low and will ramain uniform through the life of the system.
- (d) The conveyor haulage system is not hampered by inclement weather, ensuring a heavy uniform flow of material to the terminus.
- (e) The conveyor system can be operated by relatively unskilled labor, a considerable boon in these days of tight labor.

Other materials handling methods were examined during the course of our studies but it was agreed that conveyor belt haulage best suited our requirements.

Ideal Material to Convey

The material conveyed at Steep Rock is moderately friable iron ore weighing approximately 140 lb per cu ft when broken. The moisture content averaged eight-ten percent and the material is highly abrasive. A screen analysis of the feed indicates that 50 percent of the feed will pass at four mesh and 80 percent of ma-

terial will pass at one in. Marketing requirements demand that all ore must pass through an eight-in, square opening. This makes an ideal material to convey. With proper chute design the fines form a cushion to protect the belt cover from the impact of the larger lumps. This cushion of fines also serves to "bed-down" the lumps to prevent "roll-backs."

Short Center Conveyors Employed

Steep Rock Iron Mines does not employ any extremely long center conveyors. The longest flight in service is slightly over 1100 ft center to center. The feasibility of constructing much longer flights was investigated. The reduction in amount of drive equipment required, fewer transfer points (one of the prime sources of trouble in any conveyor system), the simpler electrical control circuits, more efficient use of installed horsepower, etc., all combined to present a very strong case for long center conveyors.

Conversely, long center conveyors would have entailed numerous rock-cuts which were avoided by changes in alignment of the short flights. The rock excavation would have nullified any capital advantage in the long flight system. Very large drive units and heavy specially constructed belts would eliminate any possibility for carrying a spare belt.

Finally, all production on the Steep Rock Iron Range will ultimately be won by underground methods and it is intended to salvage the surface conveyors for underground service. It is felt that a number of moderately sized units would be more readily adapted to any underground plan.

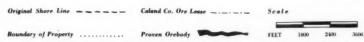
With the decision to adhere to short center conveyors, it was decided to design all flights to utilize a 250-hp motor. This standardization of drive units allows for a minimum inventory of spare parts. All production of ore at Steep Rock is dependent upon conveyors, so it is our practice to stock a spare motor, speed reducer and belt. This is considered to be cheap insurance against a prolonged shut-down.

Maximum Slope—18°

The original intent was to limit the slope of all conveyors to a maximum of 16° but adverse topography made it necessary to construct two flights at a slope of 18°. Experience would indicate that this slope is too steep for the material being conveyed. If the percentage of lump ore in the feed, that is material in the plus four in. to minus eight in. range, rises much above normal, there will be some "rollbacks" with the consequent hazard to personnel and equipment. The flights that are constructed at an angle of inclination of 16° or less do not experience any difficulty under similar circumstances.



STEEP ROCK LAKE AREA



The operations of Steep Rock Iron Mines and Caland Ore Co. are scheduled for a total annual production of 8½ million tons by 1962

Where it is necessary to load on the slope, it is our practice to limit the angle of inclination of 7° for a distance of 30 ft from the loading point. This slope assisted by properly designed skirting ensures that the belt is loaded with a minimum of swirl and scour.

Proper Design of Vertical Curves

The vertical curve is very much a part of most pit conveyor systems. The proper design of these curves merits considerable attention. The badly designed concave curve is obvious and is usually corrected immediately. A condition much more destructive of belt and idler life can exist at a convex curve and it will not be noted.

Concave curves are designed on the premise that the conveyor belt is to be started fully loaded except in the region of the curve. Our experience indicates that if a concave curve layout provides a radius of sufficient length to prevent the empty section of the belt from lifting, we do not have to fear low edge tensions or excessive center tensions in the carcass.

The radius of convex curves should be designed to limit the idler pressure due to belt tension in the curve to a pre-determined value, to prevent excessive edge tension in the belt and at the same time maintain sufficient tension in the center of the belt to prevent buckling.

With our moderate tensions (550 lb per in. of width), radius of convex curves is based on an idler spacing of two ft and a change in grade of $1\frac{1}{2}$ ° per idler. This ensures that the radial loads due to belt tension in the curve do not exceed 100 lb. Edge tensions need not be considered unless the ratio of average tension per inch of width at highest point on curve to rated tension for belt becomes quite high (80-85 percent).

Belt Speed and Capacity

The open pit conveyors must be capable of delivering 2,500,000 gross tons of ore to the loading terminal during a shipping season which averages 160 days. The open pits operate on a 24 hour per day schedule but actual production time will average about 20 hours per day. To attain the average daily tonnage of 15,700 gross tons, the conveyors are required to handle 785 tph. This figure is increased by 25 percent to allow for peaks and surges to arrive at a design figure of 1000 gross tons per hour.

Belt speed affects only the power required to move the empty belt, which varies directly as the speed. As this power is generally relatively small, the overall effect on total horsepower is generally small. On the other hand, the effective tension varies inversely as the belt speed. An increase in belt speed that will show a small increase in total power will mean considerable decrease in effective tension.

Thus it is possible to fix capacity, installed horsepower, center distance and vertical lift for a given flight and to utilize the belt speed as a means of adjusting maximum tension and cross-sectional loading. In this case, it was felt that a 36 in. wide belt operated at 550 fpm best suited the application. The maximum tension is moderate and does not require a special carcass construction. special carcass construction. The cross-sectional loading is light (50 percent). The material being conveyed rides well at this speed and the light loading minimizes the nuisance of clean-up.

Squirrel Cage Motor—Hydraulic Coupling Combination

All prime movers are 2300/3/60 squirrel cage electric motors rated at 250 hp, at 870 rpm. This motor drives a double reduction speed reducer through a hydraulic coupling. All speed reducers are directly connected to the conveyor head-shaft.

The back-stop mechanism is built into the speed reducer. None of the conveyors exhibit any tendency to drift, so solenoid brakes are not required on the motor shaft.

The hydraulic coupling installed is of British manufacture. This installation makes it possible to start the squirrel cage motor direct on the line with no resort to reduced voltage starting gear.

It is a scoop controlled hydraulic coupling equipped with centrifugally operated quick-emptying valves. These valves are adjusted to remain open until the motor has accelerated to about 90 percent of full speed. When the valves are in the open position, no oil can remain in the driving circuit. This allows the motor to accelerate to almost full speed under virtually no load conditions.

To duplicate this condition on a coupling which was not fitted with quick-emptying valves, it would be necessary to disengage the scoop prior to energizing the motor and then, after motor has reached full speed, to slowly re-engage the scoop. The scoops on our installations are locked in the fully engaged position and are not moved unless it is desired to reduce belt speed for inspection purposes.

Couplings are regulated to give an acceleration of 1.0 fps². This allows for a smooth start without unduly high tensions. Numerous checks on input and output speeds have indicated a slip of about 2 percent in this coupling. None of the couplings are fitted with oil coolers. Despite repeated starts under full-load conditions and continuous operation, we have not experienced any difficulty due to excessive heating of the oil.

The capital cost of the squirrel cage motor-hydraulic coupling combination will average about 75 percent of the cost of an equivalent drive with reduced voltage starting gear and will approach performance of a wound rotor motor installation. The simplicity of the hydraulic coupling installation coupled with its low maintenance cost does much to recommend this type of drive.

Pulleys Covered With Lagging

Conveyor belts are of plied construction as it is necessary to use as large diameter pulleys as practicable. Face widths are six in. greater than width of belt.

All head and snub pulleys are covered with ½-in. chevron grooved lagging vulcanized in place. The rubber lagging serves its initial purpose of increasing the coefficient of friction between the drive pulley and conveyor belt and at the same time the grooving allows the rubber to flex sufficiently to do an excellent job of preventing build-up on the pulley. The bare steel pulleys build-up quite rapidly. In any future installations, the lagging of all pulleys other than the tail pulley will be considered.

All pulleys are heavy duty cast iron. Based on our experience, a decided preference has been developed at Steep Rock for the split hub type of pulley. The company had two head pulley failures. In each case the pulley involved was a heavy duty cast iron pulley to which the head shaft was fitted by a light force fit. The arms broke on the outboard side of the pulley near the hub. There are a number of possible reasons for these failures-a faulty casting, insufficient fillet between arm and hub, improper stress relief or damage to pulley by careless shop work during the fitting of the shaft. Management believes that it was the latter.

Idlers

All idlers are six in. in diameter and are of one piece cast iron construction. Graduated idler spacing is used throughout. The troughing idlers are spaced so as to maintain a sag of 3/16 in. per ft of span throughout the system. Idler spacing of greater than 72 in. is not attempted. The spacing of troughing idlers is reduced to 24 in. at all convex vertical curves. Return idlers are spaced uniformly at ten ft centers.

All existing conveyors have selfaligning idlers at approximately 50-ft intervals on the carrying run and at 100-ft intervals on return side. The maintenance on these idlers is high and their value as a belt centering device is limited. On future conveyors, the number of self-aligning idlers will be sharply curtailed.

At the transfer points solid rubber impact idlers with the idler frame mounted on rubber are installed at 18-in. centers. The most serious impact is encountered at the point where the feed enters the system from the crusher. An extra heavy duty impact idler of the "Limberoller" type gives good service in these locations.

The perfect belt cleaner has yet to be invented, so as a result there is a considerable build-up on the return idlers for some distance back from the transfer points. Numerous types of return rollers have been used. The rubber covered spool or spiral type of idler has the least tendency to build-up.

It is very difficult to train conveyor men to avoid excessive lubrication of the idlers. The excess grease is discharged around the bearing and centrifugal force carries it outward to the roll surface and into contact with the undersurface of the belt. In one instance, the undersurface of a conveyor belt became so grease laden that it was necessary to wash down the entire length of the conveyor.

Transfer Points

The transfer points are the heart of any conveyor system. If these operate well, the system should be relatively trouble free.

The majority of the transfer points have deflections of 15° or less, so it is possible to make a direct transfer. A chute of local design is used at these points.

The design of the slide plate in this chute ensures that the fines reach the belt first to form a cushion for the larger particles which are deflected from the head-board to the slide plates. All material is directed along the line of the out-going belt and with an appreciable velocity. This reduces the power consumed in accelerating the load and minimizes the scour of the abrasive material on the belt cover.

Originally, the head - board of this chute was protected by abrasion resisting plate. This plate required frequent replacement so a substitute was sought. During the past two shipping seasons, a specially constructed rubber shock pad has been used successfully.

At the transfer points where the flights intersect at an angle of greater than 15°, it is found advisable to use a short center transfer belt. The additional cost is well justified by the trouble-free operation attained.

At the point where the feed enters the system, a short expendable conveyor is installed. This belt serves primarily to protect the trunk conveyors from damage by tramp iron, particularly shattered churn drill casing. A magnet cannot be depended upon to remove this material, so it is the duty of the crusher operator to maintain a look-out and retrieve any foreign objects as they cross the scalping screen. If he fails to retrieve the material on the screen, the expendable belt is stopped and the foreign object removed.

Some experiments in monitoring a transfer point with closed circuit television have been carried out with indifferent success. Poor installation, poor lighting and employe resistance contributed to the failure of this experiment. It is felt that under other conditions, this mode of control would have considerable to offer.

Control Station Adjacent to Each Conveyor Drive

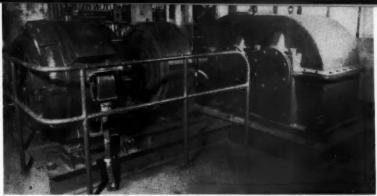
As is usual all conveyors are elec-A centrifugal trically installed. switch located near the tail pulley of each conveyor is actuated by a live shaft idler. The switch is set so as to make it impossible to start a conveyor until the flight preceding it in the system has attained 80 percent of full speed. Conversely, if a conveyor should slow down to less than 80 percent of full speed, all flights behind it in the system are stopped.

Normal control is from the head end of the system. The control system is designed for sequence starting of the conveyors governed by the centrifugal switches. An indicator light glows on the control panel for each conveyor as it enters the system. This enables the operator to isolate any

trouble spot.

As required by law, there is a control station adjacent to each conveyor drive. The interlock can be set to manual control to allow the conveyors to be operated individually for maintenance purposes, utilizing the local control station.

In the event of an emergency, a conveyor can be stopped by the local control station, by the emergency cord which runs along the gallery or in the case of a plugged chute by a diaphragm switch in the chute. Commu-



The simplicity of the hydraulic coupling installation together with its low maintenance cost does much to recommend this type of drive.

nication along the conveyors is by telephone.

This system of control has generally given good service but too much time is consumed in trouble shooting. Any fault can conceivably lie anywhere from head to tail of the system and is very difficult to isolate. An electrician can spend an hour locating a fault which may take five minutes to correct.

Life Expectancy of 17 Million Tons

All conveyor belting is of premium grade, 3500-4000 lb tensile cover stock and 20-24 lb friction. All belts carry a 5/16-in. cover and 1/16-in. back with a single leno breaker. Plied construction is used throughout. All splices are vulcanized.

The choice of cover gauge was based on the necessity for having a cover sufficiently thick to protect the expensive belt carcass from normal wear and tear during its expected life-time of 17 million tons and yet approach as near as possible to the ideal situation, where the belt cover and carcass fail concurrently. The oldest belts on the property have moved about 50 percent of the expected tonnage. A visual inspection would indicate that barring accidents these conveyor belts should attain the life expectancy of 17 million tons.

Although all belts are of plied construction, no attempt has been made to standardize on carcass construction. The older belts are of cotton duck or cotton-nylon fabric and have given excellent service. The most recent purchases have been plied up from rayon fabric. The very low stretch (1/2 percent) of this rayon fabric makes it very attractive when the take-up distance is limited. The rayon belting troughs exceedingly well and it is felt that it will exhibit a better flex life and impact resistance than other belts on the property.

No cord constructions are used on the open pit conveyors. The tensions are moderate and would not utilize the high strength of the cord carcass efficiently. Also, it is felt that emergency repairs are more easily carried out in dealing with a ply type conveyor belt. Finally, the cord belt sells at a premium price and the life expectancy of the pit conveyors does not justify the extra cost.

At the Errington Mine, where all underground ore is hoisted over a 4300-ft conveyor system, the life expectancy is 20 years or more. All trunk conveyors in the Errington system are cord type construction.

Maintenance Program

It is our experience that a well organized preventive maintenance program will enable a conveyor system to operate at almost 100 percent efficiency. At one time, our preventive maintenance left a great deal to be desired and the conveyors were plagued with innumerable minor shutdowns and repair work. These shutdowns coming at times when the pit was in full production, resulted in lost tonnage which could not be regained except at the expense of overtime work.

The present practice is to maintain a small inventory of critical com-ponents—individual idler rolls, complete idlers, pre-cut chute liners, precut skirting rubber, etc .- on hand at all times. The belts are inspected regularly and potential trouble spots are noted. At the next opportunity, possibly a pit blasting shut-down, a lunch period, etc., this faulty equipment is replaced. The mechanical equipment thus removed from service is repaired and put into inventory.

The conveyor belts are examined for cuts and abrasions at frequent intervals. When any damage to the belt is discovered, the damaged area is scived out, the carcass thoroughly dried with infra red lamps and a cold patch is applied as soon as prac-

ticable.

This cold patch is now considered as a permanent repair. The original cold patches were applied as an expedient pending a shut-down of sufficient duration to allow proper vulcanized patching. It was found that after long periods of operation, the cold patches did not "open up" as expected. As a result, this method was adopted for belt repairs. After four years' service, during which some of

	Cost/Ft Ct.	Cost/Belt. HP	% Total Cos
Prepare Site	\$ 3.00	\$ 13.00	2.3%
Foundations	\$ 4.00	\$ 16.00	3.1%
Structures	\$ 34.00	\$148.00	26.5%
Mechanical	\$ 74.00	\$309.00	58.1%
Electrical	\$ 13.00	\$ 54.00	10.0%
TOTAL	\$128.00	\$540.00	100.0%

Operating Costs-Four Cents/Ton

the conveyors carrying cold patch repairs have moved nine million tons of ore, we have no reason to doubt the validity of our choice.

Construction Costs High

The construction costs for our pit conveyors are quite high. The vertical alignment follows the ground where possible, but in some instances it was necessary to excavate through rock and in others to lay down heavy fills. In some areas, it is necessary to put down churn drill holes, case the holes, concrete them and pour caps to provide ample bearing for the towers. All conveyors are carried on a light truss, which is partially enclosed as a protection against sun and wind. A walkway is carried along one side. It might be noted in passing that the original conveyors were equipped with cleated plank walkways, which were found to be hazardous in wet weather. A metal grating is now used on all walkways. Construction has been carried out in weather ranging from minus 30°F to plus 100°F. Our average costs would be as shown above:

The pit conveyors operate on a 24 hour per day schedule during a shipping season of approximately 160 days. Conveyor men are stationed at all transfer points and are responsible for greasing and clean-up along the conveyors. It has been contended that the men could be eliminated at most transfer points other than at times when very sticky ore is in the system, but the operators will not accept this. They claim that if the conveyor men were removed, it would only mean that the job title would be revised to greaser and clean-up man and would result in no gain, while they would lose the advantage of having a man stationed at all potential trouble spots.

The Hogarth Mine conveyors system elevates material through 500 ft in a distance of 3500 ft for an average operating cost of:

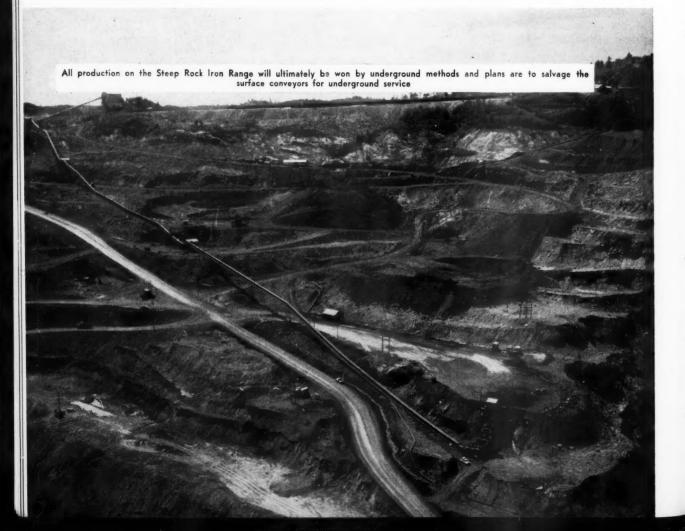
Operating										
Operating	Supp	li (28							\$0.0005
Repair L	abor .									\$0.0100
Repair St	pplies				,					\$0.0090
Power										

\$0.0407

Conclusion

At the present time, another orezone is being stripped of clay preparatory to commencing open pit mining operations. Past experience with conveyor haulage makes the choice of a haulage medium for this pit a simple one. It is doubtful if any other medium can approach the conveyor for the dependable service, high efficiency and low capital and operating costs, under similar circumstances of terrain.

In conclusion, it is felt that in any operation where material must be moved in bulk, through rugged terrain and under often inclement weather conditions, the belt conveyor merits serious consideration as a haulage medium.



Here is how a 12,000 tpd coal operation in West Virginia approached the problem of transportation behind continuous mining machines

Shuttle Cars

From Face

to

Intermediate Haulage

By MICHAEL M. O'BRIEN

Assistant Superintendent Pocahontas Fuel Co.

THE employment of today's continuous mining machines has stimulated considerable interest in the transport of their product to the mine's arterial transportation system. This crucial link, sometimes expanding, sometimes contracting, between the face and the coal won and counted, lies in a shadow-land of economics, special equipment and extravagant argument. Although it is a problem in transportation, it is seldom integrated with a mine's haulage per se. Transportation men tend to regard it as a "face" problem and "face" men find it a convenient refuge in any controversy. These remarks are made to emphasize the formidable problem that exists in this particular phase of our mining operations and to deny, generally, any claim to the best or only method of approach to this problem. Managements must recognize that in many cases their mine transportation systems have just grown like "Topsy"; that when modernizing the haulage, companies seldom go all the way to the face, and that they are continually in the process of adapting new equipment to their circumstances in an experimental, piecemeal fashion -very often without a basic understanding of, and will for, the great goals that can be won.

Mine Developed in Conventional Track Haulage Manner

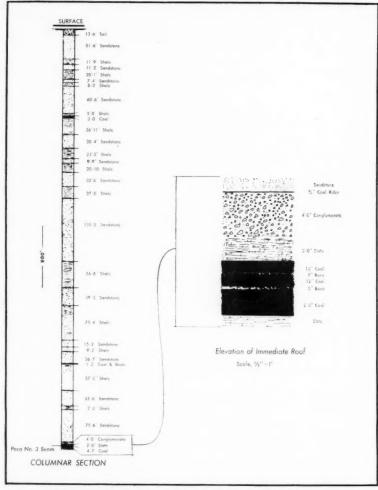
It seems desirable at this point to describe the Itmann mine. This digression is necessary for you to appreciate our situation at the time the first continuous mining machine was introduced and to understand our efforts since then.

The Itmann mine of the Pocahontas Fuel Co. is located in Wyoming County, W. Va., on the Virginian Railway. It is operating in the Pocahontas No. 3 seam, which averages about 52 in, in thickness at this location. The immediate roof is a shale from 2 to 15 ft in thickness; it may be either very weak, full of small slips and without definite stratificationalmost clayey in nature-or it may be fairly strong, standing well with careful support. A fine grained conglomerate, usually four ft thick, generally follows this slate. A small seam, 1/2 to 2 in. thick, lies between this conglomerate and the main top, a massive sandstone about 80 ft thick. The remaining section consists of varying layers of shales and sandstones for a maximum cover of 1000 ft. The bottom is a firm shale which, if properly drained, makes a good haulway for shuttle car operation. Grades are not a serious problem. Good mining conditions are maintained as far as possible by thorough roof bolting and careful timbering, especially in pillar work. Any relapse from mine standards in either of these details would leave us with just another ordinary coal mine.

The mine was initially opened during World War I and, after several years, operations were suspended until 1950. Since 1950 the mine has been in continuous operation, ranking

third among the nation's coal mines in 1955 and 1956, and first in West Virginia in those same years. It is currently shipping about 12,000 tons daily.

The property was developed in the conventional track haulage mannercentrally located main entries and widely spaced cross entries parallel to each other and at right angles to the mains. Speaking generally, an area is first surrounded, so far as practicable, with return air headings. An adequate barrier is established paralleling these headings. At varying intervals the barrier is pierced by multiple heading service entries which are turned right or left behind the barrier and driven along its inby perimeter as a barrier entry. heading panels are driven off these barrier entries with an unbroken 150-ft pillar between panels. Panel headings are driven about 16 ft wide on 75-ft centers and breakthroughs are on 100-ft centers. Panels are about 1800 ft deep, depending on the area to be mined. Panels are butted off with a bleeder heading and retreated to the main entry barrier, the barrier entry chain pillars being removed in the regular order of pillaring. As pillaring progresses across and beyond the points where the main entry barrier has been pierced by service entries, these service entries are provided with regulators and serve as bleeders for the gob areas just created. The result is that the gob bleeds directly into the main return air courses.



Geologic section of strata overlying the Pocahontas No. 3 coal seam

It should be noted here that for economic and mining reasons, it has always been the policy of Pocahontas Fuel to do complete mining. A high percentage of recovery is a "must" and it is our experience that the highest percentage of recovery in our field is best obtained by the "open-end" method of pillar recovery—the method Itmann employes.

Equipment Used

Currently, mining equipment consists of nine off-track conventional units and seven continuous mining units operating a total of 45 unitshifts daily. Conventional units consist of one 14-BU loading machine, one 11-RU universal cutting machine, two 6-SC shuttle cars and a roof bolting unit. A continuous mining unit consists of a Lee Norse machine and two or three 6-SC shuttle cars. The normal labor complement on conventional unit sections consists of 12 men, including the foreman. On con-

tinuous mining sections, a crew of eight or nine men, including the foreman, is being used as shown below:

2—Continuous mining machine op-

2 or 3—Shuttle car drivers

2—Timbermen

1-Boom man

1-Foreman

The first Lee Norse machine came to Itmann in October 1955. As of that time, the mine was almost completely developed. Considerable pillaring had already been done and most of the mine's conventional units were either driving up panels preparatory to pillaring or retreating previously developed pillars. The mine had no belts or chain conveyors. It was believed then that the continuous mining machine was especially suited to pillar work, and the flexibility of movement so desirable in pillar work did not permit, in our opinion, the introduction of additional or auxiliary equipment which might hamper or restrict the movements of the machine in the face area. Accordingly, the continuous mining machine was substituted for a conventional loader and universal cutter on a pillar section. The shuttle cars remained to receive coal from the continuous mining machine, carry it to the loading point and discharge into the mine cars as before.

Shuttle Cars Behind Continuous Mining Machine

So much for background. Confident as management was about the possibilities of the Lee Norse, it had no actual operating experience with the machine. Very few people had at that time. On the other hand, shuttle cars, as major components of our conventional units, were very familiar. Like others, the company had developed and learned certain procedures, fairly standard, for routine situations in our mining progress. Thus our first problem was to discover how easily the new machine would lend itself to practices, projections and a mining plan already very well established and actively pursued.

The use and the advantages of shuttle cars behind the continuous mining machine can best be illustrated by an account of some of the practices especially related to and involving the shuttle cars.

Moving a section ahead or back is one such situation. In our triple shift operation, sections must be moved on shift as expeditiously as possible. A moveup consists of drilling, shooting and loading out the new boom hole, laving track for the new loop and the actual move of equipment to the new location. In practice, the boom hole is drilled with the roof bolting equipment. It is shot so that the Lee Norse may load it out. Track is laid as the section advances. When the first line of breakthroughs inby the new boom hole is complete, the loop is laid. Shuttle cars haul over this loop until the move is made. Just before moving and while still loading at the old boom, the old loop is broken outby the end of the trip under the boom and the rail reversed to complete the new loop. With loading completed at the old boom, shuttle cars hook to the steel ramp and the hoist and drag them 200 ft to their new positions. The actual interruption of face activity for moving is approximately 45 minutes and a skillful foreman enjoys concealing his moves from the mine dispatcher.

Moving back, when the section is retreating, the hoist is used to move the ramp to the old boom hole, while the shuttle cars are supplying the faces and being loaded for quick discharge at the new setup. Again, the shuttle cars haul over the track of

the inby loop until it can be removed. No more than 45 minutes need be allowed for this interruption.

Triple shifting also results in supplies being delivered to the sections on shift. The mine cars are loaded on the surface and routed to the section along with the empties for the section, by the dispatcher. As the trip containing the supply cars is passing under the boom and being loaded with coal, it is broken when the supply cars reach the first place before the boom. A shuttle car pulls up to the mine car and is loaded directly for the face. The remaining supplies are unloaded at that point. Supply handling is no inconsiderable item. A section on pillars will use three mine cars of posts or 180 posts per shift.

Pillars Mined Open-Ended

Pillaring with the Lee Norse has developed several other consequences favoring shuttle cars. As mentioned earlier, pillars are mined open-ended as standard practice. With conventional mining units, panel pillars are attacked simultaneously across a face approximately 550 ft long angled about 45° to the original development. With the continuous mining machine, a flat pillar line is maintained and it may be as much as 625 ft long. For anything much over this length an additional machine is used.

The machine begins by driving halfway across the panel barrier, continuing the last open breakthrough. At the halfway mark it turns inby toward the old gob, parallel to the original direction of development, and splits the barrier to the gob. solid block between the developed pillars and the gob is then completely removed by consecutive open-ended lifts-about five in all, approximately 24 ft wide. At least four rows of wooden posts set on two-ft centers along the open side are placed as soon as enough coal is removed to place them. Each two rows of posts are set under a half header to minimize dislodgement and strengthen the effect. A travelway about 15 ft wide is maintained between the solid rib on the pillar side and the gob timbers. When the lift exceeds 20 ft in width, an additional row or rows of posts are set depending on top conditions. Posts are not set on the pillar side of a lift unless conditions require them.

After this block is removed, the next two in line are removed, one at a time by consecutive lifts from the entry first, then from the crosscut and so on until the pillar is worked down to an eight or ten-ft peg, known as the "push-out." Additional posts are set on both sides of the machine for maximum protection as this coal is being taken.

The continuous mining machine then moves to the opposite side of the line, across the same last open break-through and, beginning with the end pillar, removes it in similar fashion, then falls back to the next pillar in line and removes it and so on until all pillars on the line are removed excepting the two center pillars. They are removed by taking consecutive lifts off each, right and left, until both are entirely extracted. Here as the lift adjacent to the gob is removed from one pillar, ample breaker posts are set in the mouth of this lift to protect the approach of the opposite lift. Posts are also set on the pillar side of these lifts as a further protection.

The flat pillar line resulting from this method greatly reduces bottom trouble between the face and the boom and by eliminating the angle so necessary to the operation of a conventional unit reduces and balances shuttle car travel across the entire pillar line. The "point" of a conventional line is eliminated and its troubles also.

Flexibility and Maneuverability Required

Thus our company has discovered in connection with its utilization of the continuous mining machine certain advantages which, to us, lie with shuttle car haulage. By eliminating the point of the conventional pillar line, buggy haul has been shortened and our roadways are holding up much better.

Pillaring as it has been described, with complete extraction as our goal, and the avoidance of stumps, pegs and fenders by open ending the work, requires a certain flexibility and maneuverability which suits shuttle cars quite well.

An average of 180 posts are brought to the face each shift, in addition to various other items. These materials are brought as needed, in the quantities needed. In retreating work it is not feasible to store these quantities at the face at the beginning of a shift, for example. Shuttle cars again provide this flexibility in supply handling.

It is a characteristic of the Lee Norse machine that it can "make coal" without loading it. The coal is cut down ahead of its loading arms in its cycle of operations preparatory to loading. On pillars, this permits an accumulation ahead of the machine in the event of buggy delay, so that often it works steadily at a loading rate of 3.5 tons to five tons per minute. Six-in. sideboards have been added to our shuttle cars to increase their capacity to five tons as a result of this.

The company must also, in its conditions, achieve a good clean up. Not only does the continuous mining machine clean up well but shuttle car

haulage allows us to maintain a better clean up than otherwise.

To give you an example of continuous mining machine-shuttle car performance in pillar work, the record for one unit for the year 1956 shows that, by months, the lowest tonnage produced was 11,859 tons of clean coal and the highest was 20,934 tons. The monthly average was 15,733 tons. The average tons per man shift for the year was 33.8 tons of clean coal. This figure varied monthly from 27.6 tons to 40.9 tons per man shift. These are all clean coal figures; for raw material add 33 percent.

Performance Patterns

In reviewing a number of time studies, some significant performance patterns presented themselves which serve to illustrate further the flexibility of shuttle cars behind the continuous mining machine.

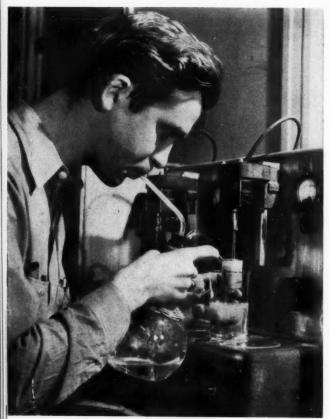
Based on an eight hour shift, the writer has selected comparative percentages for two different mining situations-one being development in solid coal preparatory to pillaring, the other retreating by open ending the pillar. In both instances, portal time required nine percent of the shift and mechanical and allied delays 25 percent. The Lee Norse waited, repositioned and maneuvered 36 percent of the shift on the pillar as compared with 21 percent on the solid. Incidentally, shuttle car travel distance was 400 ft in the pillar example, unusually long, and 200 ft in the solid instance. The machine's cutting and loading time was 30 percent on the pillar and 45 percent on the solid. Ninety-five shuttle cars were loaded on the pillar for 450 tons of material and 92 shuttle cars were loaded from the solid for 477 tons. Pillar loading was at a rate of over three tpm and solid work was loaded at a little more than two tpm.

The faster loading rate, the double shuttle car travel distance and some roof action combined to force the continuous mining machine in pillar work to wait on the buggy about 70 percent longer than was necessary in solid work without a corresponding reduction in shift tonnage.

To reduce waiting time in such situations and to more completely take advantage of the higher loading rate in pillar work, a third shuttle car is being used experimentally. The third car is expected to reduce delays due to handling supplies and to provide better service at the faster machine loading rates. It should also result in less effect on production when one regular shuttle car breaks down.

In conclusion, it is our experience that the Lee Norse continuous mining machine and shuttle cars make a good, flexible, high production team for pillar mining.

WHAT CAN RESEARCH DO



In the same way that chemistry, physics and metallurgy are now used to improve extractive methods, the refinements of modern applied science and economic planning must be used as an aid to management in the decision-making process if maximum profits are to be realized

For Management

Problems in Mining?

In these days of intense competition, rapid changes in industrial technology and the effects of imports from abroad, successful mining companies need an "extra something" to increase their profitability. This may be the willingness and ability of top management to use modern research techniques for solution of its problems

THE day has passed when research was limited to product and process development. Today the word research also embraces the systematic seeking of new knowledge in every field of professional endeavor. You are all familiar with medical, historical, and social research projects. This article will deal with research in the management area.

What can the scientist and the engineer bring to bear on management problems themselves? How, for example, might a chemist or physicist or engineer apply his approach to solving problems historically left to experience or educated guesswork?

The mining industry, like other industries, has routine situations that require little more than experience for their solution. The arts and skills

passed from one generation to the next have produced that experience.

There are other problems, however, that have grown with the expansion of our national economy and with the quickening pace of competition. These are closely linked to a company's fight to maintain its health.

Experience, an asset shared to a considerable extent by all in the industry, when applied to these major problems, can assure a company of, at best, mediocrity. Therefore, the above-average company must find other tools to achieve and hold the enviable position that competition seeks.

Profitability Measures Success

The measure of success in today's industrial world is not given in terms

By D. REID WEEDON, JR.

Vice-President Arthur D. Little, Inc.



of efficiency or progressiveness, but rather in profitability, without which no company can for long survive. To attain profitability in this era of intense competition, the company needs an "extra something."

This "extra something" is the company's willingness and ability both to

solve its problems swiftly and to recognize its opportunities early. The dispensing of experience for the day's little problems defers consideration of major opportunities. How often has this concerned you?

The writer is in no way depreciating or suggesting a substitute for management judgment based on experience. However, experience can be augmented by research, by modern research techniques that started in the laboratories and have found their way into successful use in the management sphere. With this combination a company can increase its operating efficiency and gain that "extra something" that puts it out in front.

The growth of management research has been most significant in the application of the methods of laboratory experimentation to the observation, simulation and integration of the many management functions. Research can help management in any industry by the improved observation of problems as an aid in the decisionmaking process. Research people must be trained to examine critically all factors influencing management decisions. Research can help any management by the simulation of large systems through a model, so that cause and effect and action and reaction can be observed before costly moves are made. It can help any management at integration—the fitting together of the many management functions into a meaningful whole.

Though space does not permit consideration in depth of traditional research and engineering in the mining industry, a few comments would help at this point.

Mining Industry Not High in Research Expenditures

Much has been said about the results of research and engineering in the primary metals industry. It is significant, however, that the industry as a whole does not stand high among others in expenditures for technical development. No one would say that every industry should devote the same high percentage of sales income as do several of the leaders such as aircraft, electronics, and pharmaceuti-cals. On the other hand it is worth noting that among the industries experiencing difficulty in today's economy are many of those near the bottom of the scale in research expenditures such as textiles, transportation, and leather. There is always the exception-the company with the "extra something."

Is the relative standing of the primary metals industry really a sign that managements are not aware of the earnings potential that can be won with technical development? The writer doubts that this is the underlying reason and suspects instead that as one of the more mature industries.



Managements must require that their research departments keep their eyes on the future as well as on the present

management has not done all that it might to convert dreams and aspirations to reality. Management in some of the technologically newer industries has found it possible to achieve more specific and more accurate plans than had heretofore been thought possible or reasonable. These plans have given management a rallying point around which to build a degree of enthusiasm so necessary today, when management is less synonymous with ownership. Management cannot be content to sell itself on a plan; it must sell ownership that the plan is the best opportunity among alternate demands for capital.

By way of example, the research department of an electronics company had devised a technically intriguing and workable railway traffic control system. By use of techniques developed in the last decade, it was possible to provide management with a specific and detailed evaluation of the system based on a comparison of over-all economic efficiency with the existing systems.

This comparison involved examining the operation of the systems in a number of actual railroad operation situations, but required no hardware for the new system. A paper evaluation of the performance of the new system enabled management to have information for planning purposes that formerly would have resulted only after extensive actual trial operation.

The effort to realize maximum profit must continue, unbroken, over the life of the company. The delicate balance to achieve this end requires the refinements of modern applied science and economic planning in the same way that chemistry, physics and metallurgy are now used to extract the maximum amount of saleable product from ore.

Government and Mining

This article will present several opportunities in which mining management could, through research, gain that "extra something." Has the mining industry taken positive scientific steps to attune its operations to the uncertainties brought on by foreign competition and the changing picture of Government supports? Are there any practical criteria to aid management in its decisions regarding tonnage to be mined under changing market demands and prices?

A brief word about Government. There is a close relationship between Government and the mining industry. Frequently the industry, for its benefit, asks Government to take some action. You know your own objectives, but are your requests well thought through and convincing, based on thorough research? You'll most help yourselves by making it easy for Government to make decisions based on a well-supported proposal.

Operations Research

Since prices and demand vary widely, the mining industry is constantly facing a major decision. Should a company expand or contract, should it maintain mines not required for current production, should it stockpile ore? What is the best use of invested capital? What are the opportunities for new capital?

This is perhaps the most vital strategic problem the mining industry faces, and a very complex one,

Decisions of this sort should be based more on knowledge than on experience. The mathematical methods of Operations Research can supply management with much knowledge in this area and help with this vexing problem. Operations Research is the application of basic principles of the physical sciences to the operations of business and industry. From this new science can come facts enabling decisions that are sharper than would come from experience alone. In addition, the methods are flexible and can be modified rapidly and exactly to meet changing circumstances. Some in the mining industry are exploring the use of Operations Research today.

A large producer of margarine had a similar problem. He did business in the face of wide fluctuations in the price he had to pay for soybean oil, in the availability of the oil, and in the demand for his product.

His basic motive was like mining's. He was in business for a profit.

He could not afford to speculate on oil, nor could he allow his consumer demand to dictate his oil-purchasing policy. In either case he could run into serious difficulties. He had to decide on a policy that would allow him to follow the middle road.

Among the variables he had to consider in making his decision were processing costs, the labor situation, capital investment in equipment, and the cost of maintaining inventories. He was certain of only one thing: juggling his production rate increased his operating costs.

His was a successful company, and he did quite well at balancing these factors through experience alone. But he was in competition, and he needed the "extra something" to put him ahead of the rest.

The application of mathematical methods for balancing his production rate gave him that "extra something." The mathematics included all the variables . . . the supply and demand data, labor, production, inventory, and equipment costs, and many other factors.

What evolved was the proper schedule of production for the proper circumstances, flexible enough to be altered quickly and economically. At given intervals he could revaluate the entire picture of his operation and through mathematical methods, readjust it to maximize his earnings.

Problems of Over and Under-Supply

Do mining companies have modern methods for inventory control? Do the necessary amounts of stores, supplies, tools, and other items arrive at the necessary place at the necessary time? Is your system of services so efficient that projects are not delayed for lack of sufficient equipment, and yet storehouses are not bursting their seams with oversupply?

The physical science approach has been used by many large and progressive industries to smooth out the problems of over- and undersupply. Methods for deciding when and how much to order of stock items can be developed to give better service, lower investment, and lower costs.

Corporate and Production Planning

A second area in which modern research techniques can assist the mining industry is in product and corporate planning. The present state of the mining industry makes research as a basis for planning future activities especially timely. Specifically, many companies are considering how

to maintain earnings through upgrading of present end products. Fortunately much experience exists in the broad area of chemical and metallurgical market research to provide a background for evaluation of opportunities and the effects of further vertical integration.

The industry could do well to spend more effort in trying to anticipate its consumers' needs. There is always the tendency to fill a need after demand rather than anticipate it. A progressive company will use the science of industrial economics to learn more of its customers' fortunes . . . to look, through market research, a step ahead of the customer to discover, in advance, what requirements will be.

For example, a study of consumer trends in the food industry made by the writer's organization in 1938 for the Merchants Refrigerator Co. clearly showed a tremendous future in frozen foods. With this information the client was able to plan realistically for future needs of its own consumers.

Many industries today are mapping and carrying out integration, diversification, and internal development moves.

The direction of integration, the acquisition of new companies, internal company development, the basis of phasing new activities in with traditional corporate activities, the strengthening of the newly acquired firm when it becomes part of the parent company—these are just a few of the areas where technical-economic research can help mining management improve long-range performance.

Men trained in sciences believed far removed from the specific field of business management can often be used with great effectiveness to help management evaluate its own strate-

Not too long ago a young nuclear physicist in the writer's organization observed a similarity between the production and decay of radioactive particles from a cyclotron and the increase and decrease in sales when a particular product was promoted. From this study evolved a scientific method with which management could judge with accuracy how effective its promotional programs were and how it could take steps to improve them.

Technical Audit Provides Mechanism for Solving Problems

Opportunity exists for the mining industry to evaluate its present research activities—it is called Technical Audit.

A Technical Audit seeks to determine (1) what management expects of research and development within the company; (2) how well research and development is doing its job; and

(3) how the performance of the research and development department can be improved.

Very often a research department has been started by management without any clear definition of objectives. To the technical executives who have headed the activities, it may never seem necessary to raise the question; they know what research is and assume mistakenly that management does too. They may never have asked management to try to understand what can reasonably be expected from a given amount of technical effort, and they may never have asked for the interest and guidance management should show.

Thus the first necessity for good technical organization is an efficient channel of communication between the technical executives and top management. This must be more than a merely formal or arbitrary liaison, because the spirit in which it functions will have much to do with its success.

The Technical Audit will very quickly show where such channels of communication are missing. Frequently the trouble is a case of not being able to see the forest for the trees.

Whether or not a company research group is doing a good job can be found most readily by an analysis of its over-all program. Much can also be learned by a review of case histories of successful and unsuccessful projects.

Process and Equipment Evaluation

There are many other examples of how modern research can assist mining management.

In the field of data processing, mechanical or electronic systems can be designed to handle all the data on such company operations as sales, inventories, accounts, statistics, and so forth. Modern computers can provide a degree of control over operations impossible with conventional methods. The key to success is to develop "decision rules" by which the equipment can make choices between alternatives-not merely maintain files of records-so that management's attention can be focused on the nonroutine circumstances where judgment is required.

Equipment evaluation is another problem on which mining management may profit by research. New tools, processes, and methods may be evaluated before actual construction by simulation techniques and economic analysis. Transportation scheduling can be improved. In this manner a maximum productivity can be realized from minimum invested capital.

The economic impact of new regional development such as the St. Lawrence Seaway can be evaluated,

(Continued on page 82)



Bulldozers and Scrapers in Anthracite Stripping

High-speed rubber-tired scrapers and more powerful bulldozers make possible the recovery of coal at depths that were in the past beyond the economic stripping limit of the industry

THE anthracite coal industry is constantly increasing its demand for coal won from strippings for two reasons: first, to offset the diminishing supply of deep mined coal; secondly, to improve the cost of the coal presently being deep mined. In order to obtain this added tonnage, completed strippings are being extended and new strippings planned to depths and ratios never before attained. This presents a challenge to the stripping contractor who must, despite the added depth, develop operational plans and employ suitable equipment to produce coal within the present economic limit.

Although the role of the bulldozer and scraper units in coal stripping has in the past been primarily that of an auxiliary unit, conditions now exist where the economics of bulldozer and scraper operations can be justified. In the usual stripping, a dragline is the primary stripping unit. However, in these present day deep strippings the available dragline equipment cannot handle the overburden in one pass, thus necessitating multiple passes which are time consuming and costly and prevent the dragline from performing its primary function-that is, uncovering coal. By HARRY H. HUGHES

General Superintendent J. Robert Bazley, Inc.

Occasionally a shortage of spoil room aggravates this condition.

Under conditions such as these, the high-speed rubber-tired scraper and prime mover has been well accepted as a prime unit in removing the top level material of the stripping, thus relieving the dragline operation. Once loaded the scraper can haul a considerable distance at little added

cost, and is a much cheaper method of removal than shovel operation and truck haulage.

Self-Propelled Scraper Basically a Hauling Unit

The present day scraper ranges in size from 15 to 30 cu yd capacity and is motivated by either a two or a four-wheel rubber-tired prime mover. Both types have their advocates and critics, each with valid arguments.

The various manufacturers power the prime movers and operate the scrapers in different manners. One manufacturer employs a diesel engine for a dual purpose-to provide power for traveling through a torque converter and to drive a generator to provide electrical energy for motors operating the apron movement, steering, hoisting and load ejection. Another scraper is diesel powered through a torque converter, employing hydraulic action for the other operative scraper movements. Others are diesel powered with the operative movements of the scraper accomplished by cables, the drums for which are operated through power take off shafts from the primary power unit.

As to the operation of the scrapers, the writer believes that attempting to self load a rubber-tired self-propelled scraper is a misapplication of equipment and is economically unsound, except in specialized applications. The modern self-propelled scraper is basically a hauling unit. The great power built into it by the manufacturer is to enable the unit to carry big loads at high speeds with resultant high production, not to self load.

A push-loaded scraper will load faster and will carry greater payloads due to the fact that the load is better heaped and more tightly packed.

The rubber tires on the prime mover lack the traction to efficiently self load. Tire costs, therefore, which represent a large portion of a scraper's operating cost, greatly increase if self loading is attempted.

There are three other factors that contribute to efficient scraper opera-

- (1) Plan the loading area so that the scrapers are loading on a down hill or favorable grade.
- (2) Maintain good haulage roads.
 (3) Have the dumping area in good condition so that the liad can be ejected while traveling at a fair rate of speed.

Operators will not drive at full speed if it means physical discomfort to them to do so on rough road conditions or a poorly maintained dumping area.

As to the maintenance of scrapers, the same principle applies as to other mechanical equipment-the employment of common sense and preventive maintenance. There are, however, a few items that should be mentioned:

- (1) Maintenance of good cutting edges on the scrapers at all times.
 (2) Insistence that the operators hold the apron at the proper height while loading to avoid damage and distortion—a misshaped apron permits load leakage onto the haulage road with possible resultant tire damage. sible resultant tire damage.

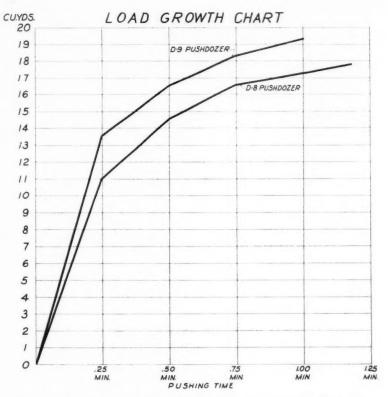
(3) Our company has found that welding a light channel section across the top of the scraper at the front end prevents the sides from bulging, and does not interfere with the loading.

Bulldozer-a Multi-Purpose Machine

The bulldozer employed as a pusher should be of ample size and power, have a torque convertor for ease of power application, and the blade motivated by cable action. Loading is a critical and controllable item in the operational cycle of a scraper.

To illustrate this point a loading graph has been developed showing the difference in time and resultant production by push loading a 20 cu yd capacity scraper with first, a caterpillar D-9 bulldozer, and then a D-8 Bulldozer under the same loading conditions.

At the start of a load, material flows into a scraper easily and the load curve rises sharply. Then as loading becomes more difficult, the curve levels off. It is easily seen, however, that the ability of the larger



This loading graph illustrates the difference in loading time and the resultant change in production by push loading a 20 cu yd scraper with first, a Caterpillar D-9 bull-dozer, and with a D-8 bulldozer under the same loading conditions

push dozer to load more yards in less time, increases the efficiency of every scraper in the operation. More pay yards per trip and more trips per hour mean lower costs and greater return for each dollar invested.

You will note that a bulldozer is suggested for push loading rather than a tractor equipped with a pusher block. The reason for this is that a bulldozer provides a multi-purpose, 60-minute hour machine. Our company has found that the contour of the bulldozer blade can be maintained if a steel plate four ft square and 34 in. in thickness is welded to the blade in the area of contact with the scraper.

The bulldozer can, besides performing its primary function of pushing the scrapers, maintain the loading area in good condition by clearing mud away following inclement weather, pushing boulders aside that are too large for loading, trimming the edges of the cut and numerous other work items.

Hydraulically Actuated Ripper

The development of the hydraulically actuated ripper mounted on a large bulldozer or the push dozer has certainly increased the scope scraper activity. The shales and soft rock that previously resisted loading by scrapers or ripping with the old cable powered ripper or rooter are now successfully loosened. The No. 9 ripper, commonly used, hydraulically actuates three arms spaced at 53 in., is equipped with detachable points, loosens a total width of a lit-tle over nine ft in one pass to an average depth of penetration of 12 in. The cost of this work, depending on rock hardness and degree of stratification should not exceed two cents per cu yd, which is, in comparison, much cheaper than drilling and blast-A word of caution, however, ing. must be added—scraper production will be somewhat lowered as it is a recognized fact that scrapers load more rapidly and fully in solid than in loose material, and this fact must be considered in computing cost esti-

Included in the work schedule of a bulldozer is the actual removal of overburden. In extending completed strippings, for instance, it is often necessary to remove the cast bank from the previous operation. This and other overburden removal can be accomplished with a bulldozer if it is carefully planned and within the scope of high productivity of the dozer. This word of caution is injected due to the fact that the production curve of a bulldozer falls rapidly over certain distances with the resultant increase in cost.

The costs per cubic yard for pushing loose material by the bulldozers are based on an efficiency of 85 percent, and an operating cost for the D-9 of \$18.22 per hour, and \$13.50 for the D-8.

Thus far discussion of the tractordrawn scraper has been omitted. This is not to be construed as an indication that the unit is not efficient or that it is not a cheap method of earth removal within restricted distances. The long hauls, however, usually encountered on the strippings makes the selfpropelled rubber-tired unit the more desirable.

A Stripping Operation

To present an example of scraper activity in anthracite stripping, co-ordinated with dragline operation, the operational plan at the Logan Mammoth vein stripping of J. Robert Bazley, Inc., will be explained.

The stripping operation consists of removing the overburden from and mining the coal contained in a seam in synclinal formation. The coal seam at the synclinal axis of the basin averages 30 ft in thickness, and is overlaid by 65 ft of a hard fine grained sandstone and 70 ft of heavy clay. The coal seam has been previously mined to the extent of approximately 40 percent of the original vein content.

This stripping, operating upon a coal salvage basis, has been in existence about ten years; however, as the demand for coal controls both the working schedule of the coal and overburden removal, the actual operating time has been about seven years. During this time 12,329,000 cu yds of overburden has been removed and 1,840,000 gross tons of coal recovered. Approximately 57 percent or 7,022,000 cu yds of this overburden yardage was removed by scrapers.

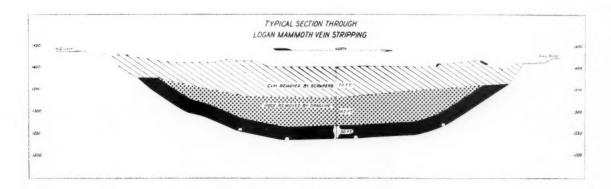
Added to the usual operational problems in this stripping is the fact that located immediately adjacent to the north outcropping is a main line double track railroad, and located adjacent to the southern outcropping is a four lane main highway. Both of these must be supported.

The operational plan must of necessity include the removal of the overburden and coal and the immediate backfill to support the railroad and highway. All overburden north of the syncline is being placed to the north by both the scrapers and the

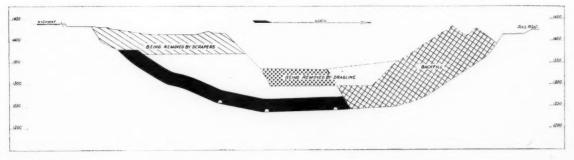
dragline. The same procedure is followed in the area south of the syncline. To accomplish this, the scrapers remove the clay from the cut immediately south of the rock and coal cut being made by the dragline, and deposit it upon the bottom slate immediately following the coal removal. This action serves a triple purpose. The weight of the clay bank serves to stabilize the overburden material already cast upon the pitching bottom slate; second, it permits the eight cu yd dragline equipped with a 200-ft boom to move transversely across the basin to take full advantage of all the available spoil room; third, it maintains a short haulage distance for the scrapers at all times.

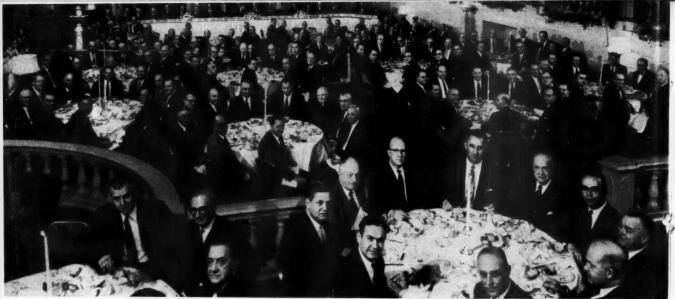
In summation, the rubber-tired self-propelled scraper and bulldozer has a definite place among the overburden removal units in the anthracite and other coal areas. The power and speed now being built into the scrapers, the improved more powerful bulldozers, and the recently developed hydraulically actuated rippers have eliminated the physical obstacles that in the past prevented the universal use of these units.

The employment of these low-cost earth-moving units makes possible the recovery of coal at depths that were in the past beyond the economic limit of the industry.



As soon as coal near the railroad and highway is mined, the area must be immediately backfilled to support the two roads





Well over 200 industry leaders were on hand for the Annual Membership Meeting at the Hotel Plaza

MEMBERS of the American Mining Congress gathered in New York on December 2 for their 59th Annual Membership Meeting. Leaders in the coal, metal mining, industrial minerals, and mining equipment industries were present for the dinner and the business session which followed.

A highlight of the meeting was the presentation by AMC president Howard I. Young of a testimonial scroll to Henry B. Fernald, chairman of the Tax Committee for many years. The scroll, signed by all members of the Board of Directors, carried the following text:

The American Mining Congress
presents this
Award of Merit
and
Tribute of Appreciation

to HENRY BARKER FERNALD

In recognition of his long and valued service as Chairman of the Tax Committee. For over 30 years he has continuously and effectively contributed to the development of sound principles of taxation as applied to the mining industry. His comprehensive knowledge of tax laws and their administration, his thorough understanding of mining problems, his rare talent of analysis and sound judgment, together with his frank and honest presentations of tax problems, have made him the acknowledged leader in this field, and have commanded the confidence and respect of mining men, members of Congress, and tax administrators. The recogni-tion accorded to the problems of the mining industry in the enactment and administration of our Federal tax laws is a monument to his devoted and untiring efforts.

American Mining Congress Holds Annual Business Meeting



Howard I. Young (right) presented Henry B. Fernald a scroll in recognition of his many years of valued service as chairman of the A.M.C. Tax Committee

Mr. Fernald expressed his deep appreciation of this tribute and said that whatever accomplishments had been realized in the field of mining taxation during the past 30 years had been due to the combined work of many persons. He went on to say that he wished he could report that the industry could rest on what had already been worked out in the matter of tax legislation, but pointed out that the work which remains to be done is no less important and no less arduous than it has been in the past.

Lincoln Arnold, tax attorney of Washington, D. C., succeeds Fernald as chairman of the Tax Committee. He was appointed at the September 10, 1957 meeting of the board of directors.

Executive Vice-President's Report

Julian Conover, executive vice-president, reported briefly on the work of the American Mining Congress during 1957. He said that the Mining Congress is in a strong position, with broad support from all branches of the industry, a balanced budget, a competent, hard-working staff, and continued recognition of the Mining Congress as the industry's spokesman in matters of national policy. After discussing the various phases of the organization's work-including the bulletin service, which keeps the members posted on current developments; the MINING CONGRESS JOURNAL, which is growing in leadership and prestige; the work of the technical committees, in which operators and manufacturers join forces in the drive for better methods and equipment, lower costs and greater safety; and the Conventions and Expositions, at which minerals and fuels policies together with new developments in operating practice and equipment are discussed-he went on to give an over-all picture of developments in Washington.

Speaking of the proposed national minerals program which was submitted to Congress early last June, Conover said that government recognition (in the case of lead and zinc) of the principle, long advocated by the industry, of applying import taxes when prices fall below given "peril points" and suspending them when prices reach a level permitting a reasonable "base" of domestic production, marked a long step forward. He pointed out that members of the House and Sen-ate Interior Committees have been openly critical of other phases of the proposed minerals program, and have intimated that they may try to write a program of their own at the next session. The report did not discuss coal problems beyond urging an "expanded research and development effort . . . to broaden the Nation's energy resource base"-and he expressed the hope that this objective will be vigorously pursued.

Commenting on the tax situation, he said that at the hearings on tax revision scheduled to start January 7, the AMC Tax Committee would urge a number of amendments that had been previously proposed, to provide more equitable treatment for the mining industry and remove some of the roadblocks to mineral development. These include: making expenditures for exploration fully deductible; extending the allowable transportation from mine to treatment plant in computing depletion; a more adequate depletion rate for coal; a more workable definition of the term "property" for computing depletion, to provide flexibility in line with operating practice; and various other provisions which are part of the industry's long-term program to remove inequities and improve the tax climate for mining. He also commented on the Treasury's regulations dealing with depletion, "ordinary treatment processes," and other provisions affecting natural resources.

One of the biggest issues before Congress next year, Conover said, will be that of tariffs and foreign trade policy. He stated that the Administration will ask for a five-year extension of the Trade Agreements Act, with power to make substantial further tariff cuts, and will also seek approval of membership in OTC. These proposals, he said, will meet strong opposition from industries which are already suffering from heavy imports. Numerous others, however, will ask Congress to repeal the "peril point" provision of the present law and to make the "escape clause" provision even less effective in affording relief for domestic industries. He said a drive will undoubtedly be made to require that the Tariff Commission's findings in "escape clause" proceedings be subject to review by Congress rather than by the President. The Mining Congress continues to strongly oppose any control over our foreign trade by an international body such as the OTC.

Several new restrictions on business were proposed during the year and, although thus far none have been adopted, Conover said we still have

them to contend with. He cited the so-called pre-merger notification bill, strongly supported by the Administration, which is in the House Rules Committee, as a measure which has political appeal and on which there is a distinct likelihood of further action. Another serious threat, he declared, is the Kefauver-Patman price discrimination bill which, if passed, could seriously affect producers of many mineral commodities.

After discussing public lands problems, labor law revision, social security, stockpiling, Federal mine inspection, SEC requirements, radio com-munications, silver legislation, natural gas, coal research, mineral purchase programs, freight rate increases, and other matters of interest to the industry, Conover concluded by expressing the appreciation of the Mining Congress staff for the opportunity to be working for the mining industry. He pointed out that there are plenty of tough problems coming, but "we'll try to be on our toes to keep you posted and to help meet them.

The treasurer's report, presented by Andrew Fletcher, chairman of the Finance Committee, showed the American Mining Congress to be operating with a balanced budget and with a satisfactory cash reserve.

Pay Silent Tribute

A silent tribute was paid to the memory of three leaders in the work of the American Mining Congress who had passed on during the year—Erle V. Daveler, chairman of the Finance Committee, 1933-1943; L. Russell Kelce, director, 1949-1957; and J. M. Bowlby, director, 1951-1957.

Royce Hardy, newly appointed Assistant Secretary of the Interior for Mineral Resources, outlined some of the problems and objectives of the Interior Department in advancing the sound and efficient development of our mineral resources. He paid tribute to Felix E. Wormser, his predecessor, and discussed briefly the development of long-range minerals and fuels policies in relation to national security and to the Administration's over-all domestic and foreign policies.

Royce Hardy, Assistant Secretary of the Interior for Mineral Resources, outlined some of the problems and objectives of the Interior Department in advancing the sound and efficient development of our mineral resources



Called upon for a few comments on the outlook for taxes as they apply to the mining industry, Ellsworth Alvord, AMC Tax Counsel, said he saw nothing but a rough schedule ahead. He predicted that industry may face a graduated tax on corporations, and perhaps an excess profits tax, and emphasized the need of maintaining a common front in meeting these problems.

Nominations for directors of the American Mining Congress were submitted by Donald H. McLaughlin, chairman of the nominating committee. They included: for a two-year term, Frank Nugent, president, Freeman Coal Mining Co.; and for a three-year term: Horace M. Albright, director, U. S. Borax & Chemical Corp.; George J. Clark, president, Reading Anthracite Corp.; Charles R. Cox, president, Kennecott Copper Corp.; R. T. Elstad, president, Oliver Iron Mining Division, U. S. Steel Corp.; George H. Love, chairman of the board, Pittsburgh Consolidation Coal Co.; L. Newton Thomas, president, Carbon Fuel Co.; William L. Wearly, president, Joy Manufacturing Co., and S. H. Williston, executive vice-president, Cordero Mining Co. These nominees were elected by unanimous ballot.

Directors' Meeting

Following the annual business meeting, the Board of Directors held a meeting, at which the Declaration of Policy adopted at the Convention in Salt Lake City in September received unanimous approval as an expression of the policy of the American Mining Congress.

Nominations for the Advisory Council of the Coal Division for the year 1958 were submitted and were duly approved. New members of the 50-man Advisory Council are: Robert K. Beacham, vice-president, Ayrshire Collieries Corp.; Stuart Colnon, president, Bell & Zoller Coal Co.; W. J. Crawford, vice-president, The Enos Coal Mining Co.; John N. Crichton, vice-president, Johnstown Coal & Coke Co.; Cecil Guthrie, vice-president, Peabody Coal Co.; H. J. Harper, vice-president, Eastern Gas & Fuel Associates; C. O. Kane, manager of coal mines, Armco Steel Corp.; H. C. McCollum, vice-president, Peabody Coal Co.; E. P. Reed, manager of raw materials, Tennessee Coal & Iron Division, U. S. Steel Corp., and G. E. Sorenson, president, The Kemmerer Coal Co.

The following officers were unanimously elected for the year 1958: Howard I. Young, president; Andrew Fletcher, Herbert C. Jackson, and Raymond E. Salvati, vice-presidents, and Julian D. Conover, executive vice-president and secretary.

Following his re-election as president of the Mining Congress for another year, Mr. Young expressed his



The joint meeting of the Land and Water Use Committees of the Amorican Mining Congress and National Coal Association was the largest ever held

appreciation of the honor and the confidence shown him by the Board, and made it clear that he wished the coming year to be his last year of service in that office. He went on to say that he had at all times enjoyed his association with the work of the American Mining Congress and that he would continue to do everything possible to assure its success.

Land and Water Use and Tax Committees Meet

At a meeting earlier in the day, the Land and Water Use Committees of the American Mining Congress and the National Coal Association met in the largest joint meeting ever held by these two groups. Land and water use developments in the various states were thoroughly discussed and field trips for the coming year were scheduled

The AMC Tax Committee members and associates held a well-attended full-day meeting on Tuesday. Chairman Lincoln Arnold outlined the presentation to be made by the American Mining Congress to the Ways and Means Committee in the January 1958 tax revision hearings. Ellsworth C. Alvord discussed the economic and fiscal outlook. Problems in connection with the determination of the "property" for depletion purposes under Section 614 of the 1954 Code were dealt with by Robert McArthur. Laurence Sherfy outlined recent developments dealing with ordinary treatment processes for depletion purposes, and distributed a summary of court decisions dealing with the problem. The rest of the day was devoted to discussion of these matters and other recent developments in the field of mining taxation.



On Tuesday, December 3, the AMC Tax Committee made plans for the coming year

Deepening of the Page Inclined Shaft with a

CRYDERMAN SHAFT MUCKER

A report on the first application of the Cryderman machine to inclined shafts in the United States

By T. M. TOWER and C. J. WARD

Respectively

Superintendent and Assistant Superintendent Page Mine, American Smelting and Refining Co.

THIS article describes the methods of deepening the three-compartment inclined shaft at ASARCO's Page mine in the Coeur d'Alene mining district, six miles west of Kellogg. Idaho. The Page shaft is a three-compartment, 55° incline, with each compartment 66 by 58 in. in the clear. Rock excavation required is 8½ by 20 ft. The shaft was sunk from the sump at the 3180 ft level to a depth of 3500 ft, a distance of 320 ft. Work was scheduled on a two shift, five-day week basis early in October 1956.

Experienced shaftmen were at a premium and of the eight men in the crew only four had previously worked in an inclined shaft. When the shaft was completed in February 1957, a total of 21 different men had worked on the job.

Drilling and Blasting

A normal bench round of 20 holes was used to break half of the shaft bottom at a time. Ground conditions prohibited carrying the face more than one five-ft set ahead of timber and, by benching, the risk of damage to timber by the blast was lessened considerably; also, the final cleanup of the bottom was made easier. All loose rock left on the high bench by the Cryderman clamshell was swept into the sump with a blowpipe, thus eliminating all hand mucking. To facilitate mucking, the face was drilled so that the bottom was normal or near normal to the incline of the shaft. This sloping bottom was difficult to stand on to drill with the conventional hand-held machines, but was ideally situated to drill 75 percent of the

holes with a jackleg. Two machines were used to drill a six-ft bench round of 20 holes. The average time to set up and drill one bench was three hours and forty minutes. Set up time was negligible as the machines were lowered to the bottom on a specially designed drill cart containing the machines and hoses already connected to a manifold built into the drill cart. Two bull-hoses fitted with snap type victaulic coupling were used to supply air and water to the manifold. When the round was drilled out, the machines and steel were simply put back into the drill cart, the bull-hoses disconnected, and the drill cart hoisted to the station. Integral carbide insert steel was used throughout the 320 ft of the shaft. Very little steel breakage was experienced, but some loss caused by sticking steel was a problem until the essentially green shaft crews became more experienced.

Forty percent gelatin powder and standard electric delays were used to blast. Fragmentation was good. Powder consumption was 20 lb per ft.

Generally, three bench rounds were blasted before timbering. The first two rounds were mucked completely out, and the third was partially mucked out to provide a level muck pile on which to stand while timbering.

First Application to Inclined Shafts

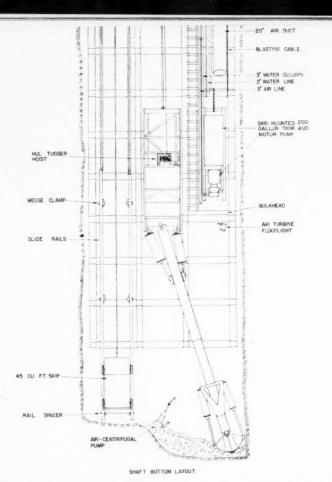
Until recently there has been little in the way of machinery developed to supplant hand mucking in a steeply dipping incline. The development of the Cryderman machine in Canada, first for vertical shaft work and more recently for use in inclined shafts, has taken some of the arduous and time-consuming work out of sinking.

The first use of this mucker for incline work was made by East Malartic Mines, Malartic, Quebec. The company utilized two machines in a large, 35 by 10 ft, 61° incline. The first machine built in the United States was used in a vertical shaft in Butte, Mont.; the second in the Lucky Friday Mine at Mullan, Idaho. The third unit, built for American Smelting Company's Page mine, was the first application of the Cryderman Mucker to inclined shafts in the United States.

Changes Necessary

In June 1956 T. Tower observed the operation of the two machines at Malartic and concluded that some changes would be necessary to use the machine successfully in the Page shaft.

On all standard machines the clam bucket is free to rotate. In order to have head room to dump the ten cu ft clamshell inside of timber, a nonrotating boom was built into the machine. This kept the clamshell in a position more or less fixed in relation to the shaft timber. This non-ro-



Sinking was started 110 ft below the 3070-ft level, the lowest operating level of the mine. A novel arrangement of sheave wheels was necessary to keep the shaft open to service this level with material and to draw the level ore pocket as well as the shaft waste pockets

tating feature was also of great help in mucking. The bulk of the broken rock lay against the footwall, and no time was lost trying to rotate the clam into position for the best bite.

Another advantage of the non-rotating boom is that two long unwieldy air hoses feeding the clam cylinders were eliminated and replaced with telescopic tubing placed along the bottom side of the boom.

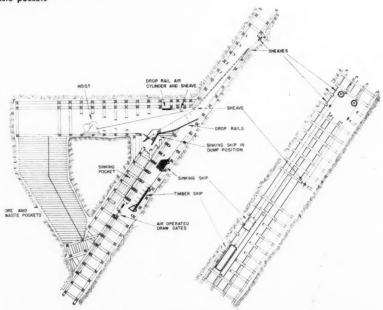
Basically, our machine is quite simple. It consists of a cage 15 ft long from which a telescopic boom is mounted on a gimbal type support built into the bottom of the cage. On the front of the gimbal and along each side of the boom, two 8 in. diameter air cylinders are mounted to control the swing of the boom from side to side. Directly under the boom, and pivoted to the bottom of the cage, are two 12-in. cylinders to control the raising and lowering of the boom. Tenin. cylinders were tried but did not give sufficient lift to the boom with 95 psi air pressure. At the clamshell end of the boom, two 6-in. cylinders actuate the clamshell jaws.

A cylinder within the boom permits an extension of 11 ft 4 in., giving the boom a total length of 28 ft. The retracted length is 17 ft. The operator is located at the bottom of the cage where he manipulates two "joystick" levers, which control the eight multiple directional valves.

For handling the mucker in the shaft, a Hul tugger hoist with a rope pull of 2000 lb was mounted in the cage in back of the operator's platform where, by double blocking with a four part 1/2-in. line, the operator could raise or lower the machine easily and quickly. These blocks were dead ended on a hook that was placed over a footwall plate. Enough cable was put on the tugger to allow 60 ft of travel in the shaft, which was more than sufficient to hoist the mucker clear of the blast. The cage was skid mounted on all four sides to prevent it from tipping and moving while mucking, incidently eliminating the cost of wheels, axles, rails, etc.

Operating the Machine

Before mucking commenced, the operator would lower the mucker into position and dig a hole for the slide rails so that the skip could be lowered as far as possible. As soon as the slide rails were in position, the 45 cu ft capacity skip was lowered and mucking started. To avoid delay in juggling the clam up or down over the skip, the mucker was so located that in the dumping position the boom



SECTION THROUGH SOTO STATION

In comparing mechanical and hand mucking in the Page shaft, an over-all saving of 4.92 manhours per ft of shaft was made by using the Cryderman machine



In order to have head room to dump the ten cu ft clamshell in the timbered area, a non-rotating boom was built into the Cryderman machine

was fully retracted. Two operators on each shift were capable of operating the machine, and in time became proficient.

On several occasions the mucker was observed mucking efficiently with the muck pile under two to three ft of water.

Only one serious breakdown of the mucker was experienced when a pipe fitting on the inside of the boom backhead pulled loose and had to be repaired.

During the early stages of breaking in mucking machine operators, four clamshell cylinder rods were bent by inexperienced operators swinging the boom into the timber.

One of the problems arising while using this type of mechanical mucker is what to do with the other three members of the shaft crew while mucking is in progress. In a shaft the size of ours it is not safe or necessary for anyone to be in the bottom while mucking is in progress. What scaling down and pump movement is necessary is accomplished during the time the loaded skip is being dumped.

One compressed air-driven electric floodlight proved to be satisfactory to illuminate the bottom of the shaft for the mucking machine operator.

Some difficulty was experienced using slide rails for the 45 cu ft skip,

as they had a tendency to bend when the skip was loaded. This was corrected by turning the base of the 40-lb rails up and running on the base of the rail instead of the web. The slide rails were placed bottom side up on the outside of the standing rails and held in place by a C clamp and wedge. A shop-made steel tie was used on the overhanging end of the slide rails to prevent spreading.

Sinking was started 110 ft below the 3070 level, the lowest operating level of the mine. A novel arrangement of sheave wheels was necessary to keep the shaft open to service this level with material and to draw the level ore pocket as well as the shaft waste pockets.

A 150-hp single drum sinking hoist was installed on the 3070 level. A pocket to receive the shaft muck was cut over the back of the shaft so that the sinking skip could back out on drop rails and dump into the product.

The skip is a 45 cu ft bottom dump skip, the bottom of which is a gate mounted in guides. Lugs welded on the bottom engage a rail which raises the gate as it is backed into the dump. When the skip is pulled out of the dump, the gate closes by gravity and the hoistman pulls it back out into the shaft. The drop rails are actuated by means of an air cylinder controlled

from the hoist deck. No skip tenders were required on the shaft project. The operator signaled the hoistman from his platform in the cage of the Cryderman Mucker.

Timbering Problems

Past experience indicated that the continued use of heavy timber would be necessary, and four men on each shift would be required to handle the timbering cycle without undue strain or delay. Also the shaft crew was responsible for the extension of pipe and vent lines. Most of this work was done while mucking was in progress.

A complete shaft set was loaded on a special timber skip at the surface and lowered to the 3070 level to be picked up by the sinking hoist and lowered to the bottom when needed. Care was taken in loading the timber so that each piece could be unloaded in rotation as needed.

Each set was lined with a transit. The transit was mounted on a screw bar with mounting head which was left in position under a line point station in the center compartment above the mucking machine. A nail driven into the center of the hanging wall plate served as a target for aligning the set, and two leveling rods were placed on the footwall plates for maintaining grade. The air-operated floodlight provided sufficient illumination for the engineer. An arrow made of reflecting tape and mounted on a pressed wood plaque was used for signalling between the engineer and the lead man who directed the blocking-in of the set.

Ground conditions generally prohibited carrying the face more than five ft ahead of timber. This condition complicated the use of the Cryderman Mucker, which hung in the center compartment, as four sets of dividers would have to be left out in order to allow the boom on the Cryderman to reach both ends of the shaft at the bottom. To support this span until the dividers could be placed, rock bolts were put through pre-drilled holes in the hanging wall plates, and the hanging wall plate was bolted to the wall with two 6-ft expanding shell

(Continued on page 56)

Parformance	R.	Comparative	Data
Performance	œ	Comparative	Data

	Mechanical Mucking For 320 Ft Advance			H For	2	
	Man Hours Per Ft	Man Hours Per 5-Ft Set	% of Total Time	Man Hours Per Ft	Man Hours Per 5-Ft Set	% of Total Time
Mucking	. 5.24	26.20	27.75	12.65	63.28	53.00
Timbering	. 3.72 . 4.90	18.60 24.50	19.64 25.85	4.30 6.92	21.49 34.63	18.00 29.00
Loading and Blasting	. 1.61	8.05	8.50	0.0 =	01100	
Rock Bolting	. 1.66	8.30	8.76			
Travel Time and Delays	. 1.82	9.10	9.70			
Totals	. 18.95	94.75	100.00	23.87	119.40	100.00

Fine Coal Cleaning with the Feldspar Jig

By EARL R. McMILLAN

Manager of Coal Operations, Northern Pacific Railway Co. Coal Department

The feldspar, or false bed, jig has been successfully used in Europe for years. Now a coal producer in the State of Washington is using one of these washers. Mr. McMillan describes his company's experience in installing and operating the jig and summarizes the results of several performance tests

THIS article is a summary report of the experience with a Baumtype Feldspar jig, believed to be the first commercial installation in the United States, in the central coal cleaning plant of the Northern Pacific Railway Co., in the Roslyn-Cle Elum coal field, Kittitas County, Wash.

Northern Pacific Railway has operated mines in the Roslyn-Cle Elum area continuously since 1886. Prior to 1897 operations were conducted as a department of the railway company under the name of Northern Pacific Coal Co. In 1897 these operations, along with other of its mineral and timber holdings, were transferred to the Northwestern Improvement Co., a wholly owned subsidiary of the railway company. These operations were established and carried on primarily for the purpose of supplying coal to the railway company for locomotive fuel. However, with the coming of dieselization of locomotive power, the rate of which was greatly accelerated following World War II, the coal requirements of the railway company diminished concurrently. Hence, in order to simplify accounting and administrative practices. Northwestern Improvement was liquidated, with all properties and operations being transferred back into Northern Pacific Railway as of December 27, 1956.

As dieselization progressed, strenuous efforts were, and still are being made to find and hold commercial outlets for as much as possible of the tonnage that formerly went to the railway company. These efforts have met with varying degrees of success, but mostly they have been hampered by competition from other fuels. First, it was cheap oil from California, then lower priced coal (by reason of lower cost of production) from

Rocky Mountain fields, and, more recently, natural gas piped from New Mexico and Canada. As a result production in 1956, for the first time since the beginning of these operations, dropped to less than 300,000 tons. Only two mines are presently operating—No. 3 and No. 9. No. 3 mine workings are entirely within the No. 1 bed, which is approximately 18 ft thick, but of which only the bottom six ft is minable. No. 9 mine workings are partly in No. 1 bed and partly in No. 5 bed, the latter being uniformly $4\frac{1}{2}$ ft thick.

To remain competitive with other fuels, it has, of course, been necessary to mechanize the mines to the fullest possible extent. This has been done, but because of adverse natural conditions, consisting of widely varying dips, 0° to 45°, with accompanying roof fractures, the degree to which mechanizing can be done is limited. Joy Continuous Miners, with shaking conveyors, are used in areas not exceeding 18° dip. In all the more steeply dipping areas, conventional pitch mining methods, using undercutting machines with shaker conveyors, are still employed.

Preparation Increasingly Difficult

As mechanization of the mines increased, and the change-over from a mine producing railway fuel to a commercial mining operation progressed, the problem of cleaning the coal, particularly the small sizes, became progressively more difficult and complex.

The first unit of the present central cleaning plant was built in 1935. This unit, which had a capacity of 200 tph, consisted of pulsator jigs (Vissac type) for cleaning the 4-in. to ¼-in. coal, and an air table (American Coal

Cleaning Corp.) to clean the minus ¼-in. coal. Two years later the air table was replaced with wet tables (five Deister Concentrator No. 7 Superduty tables), and the plant expanded to accommodate a heat-drying unit, a McNally-Vissac downdraft, hot-air dryer—the first one installed in the United States. In 1945 a CMI dryer was installed, and in 1950 a McNally Pulso (Vissac) updraft dryer, with hot gas producer furnace and dust-collecting system, was added.

With the ever increasing proportion of minus 1/4 in. size coal in the feed to the plant, and the consequent overloading of the tables, it became necessary some two years ago to consider ways and means of solving this problem. It appeared to be a question of deciding whether to install additional tables, which would require enlarging the plant, or trying to find a different and, if possible, a better type of fine coal cleaning equipment. The Deister tables were making a fairly good separation of coal and refuse as long as they were not overloaded and were adjusted to the normal feed, but, when overloaded, as they were for increasingly frequent periods, and with ever wider variations occurring in the character of the feed, they were becoming less and less effective. It was decided, therefore, to try to find a more flexible and effective type of equipment to either replace or supplement the tables.

Feldspar Jig Ordered

Reports appearing in the technical press, and discussions with first-hand observers, all indicated that possibly the feldspar jig, as presently developed and widely used throughout

Europe, might be the answer to our This jig has very large problem. capacity per unit of floor space, is highly efficient on wide fluctuations in feed, and is positively automatic in control.

Accordingly, after due consideration, arrangements were made with McNally Pittsburg Manufacturing Corp., in July 1955 to build a feldspar jig for us, using the standard Baum

jig as the basic unit. Described briefly, this jig is a standard Baum-type, two-compartment, four-cell washer, with two reject elevators-one for refuse and one for middlings. Overall dimensions of the jig are: length 21 ft, width 14 ft, and height 24 ft. The cells are each 3 ft long by 6 ft 6 in. wide; No. 1 and No. 2 cells are for refuse and No. 3 and No. 4 cells for middlings. screw conveyor in a trough at the bottom of the jig conveys refuse to elevator No. 1, and middlings to elevator No. 2. Pulsion is supplied by an Ingersoll-Rand blower at two psi pressure. Successive air impulses, at the rate of 60 per minute, are imparted through four piston valves actuated by a common eccentric shaft mounted below the washing compartments. Water is supplied to the jig from a separate head tank set 15 ft above jig inlet.

Delivery of this jig, except for the automatic control mechanism, was received in November 1955, but because of the unusually severe winter that year, installation was not completed until the following summer.

Not a New Means of Cleaning Fine Coal

Now for a word about the feldspar jig in general and its distinctive features. Feldspar jigging as a means of cleaning fine coal is not new. Luhrig erected the first successful feldspar fine-coal washer in Germany in 1867. A number of feldspar jigs were used in America some 40 years ago but all were gradually supplanted by other types of equipment. However, in European practice, particularly on the continent where sizing before washing is still common, the feldspar jig has continued to be popular. It has been consistently improved both in capacity and in the development of automatic controls, just as has happened in this country with the widely popular Baum-type jig.

Feldspar, or artificial bed-jigging, refers to the practice of using a false bed of heavy material on the jigscreen plate to prevent light material from going down through the screen

into the hutch.

The holes in the jig screen are larger than the top size in the feed, and the feldspar used as an artificial bed is larger than the screen holes. Thus, gates for removal of heavy material are unnecessary because the



Having once determined the proper settings of the counterweights on the control beams, and the water supply valves, no further adjustment of the controls is normally required for the particular coal being treated. Note in the background the scalping and dewatering screen at feed end of jig

refuse passes down into the hutch through the bed of feldspar, which itself acts as valves. Feldspar jigging may be called "washing through the screen," in contrast to the common practice of "washing over the screen." The movement of the refuse through the feldspar bed is regulated by a controlled suction. In European practice, control is accomplished by a float, suspended in the jig bed, which actuates the air valves controlling the pulsions of water through the bed. Thus, when the bed of refuse becomes too thin, an exhaust air valve on the main air chest is opened to reduce the pressure available for pulsation and thereby decrease the mobility of the bed. Refuse is thus allowed to accumulate. As the amount of refuse in the bed approaches normal thickness, the air valve gradually closes. If refuse accumulates too rapidly, the valve closes completely to give maximum pulsations, and hence maximum rate of refuse removal through the screen plate.

The most critical and important feature of the feldspar jig is the automatic control of the air pressure adjustments. These adjustments in the standard jig are made manually to suit the particular coal to be treated, but in the modern feldspar jig they must be automatically controlled to accommodate wide variations in character of the feed in order to insure, not a constant gravity separation, but a constant ash content of products.

Operation

Returning now to our own jig at Rosslyn-following completion of installation in August 1956, this jig has been operated more or less as an experimental unit for the reason mainly

that until recent weeks no satisfactory control for its operation could be devised.

Incidentally, instead of feldspar, the false bed in this jig consists of burnt shale from our old mine refuse dumps. This material ranges in specific gravity from 2.5 to 2.6. Size of pieces is approximately % by 11/2 by 3 in., with irregular shapes. The bed plate screen has %-in. round hole openings. The false bed is carried at six-in. depth in No. 1 and No. 2 cells, and at 51/2-in. depth in No. 3 and No. 4 cells. All cells are compartmented for separate pulsion strokes. The two refuse cells are partitioned from the middlings cells by a weir above the bed plate.

The feed, which is 1/4 in. to 1/2 millimeter in size, consists of the minus 4-in, material screened from the raw coal feed to the plant, plus the crushed middlings from coarse coal jigs. A double-decked vibrating screen placed just ahead of the jig removes all stray particles larger than ¼ in., and the minus ½millimeter material, together with most of the water with which the feed is sluiced to the jig.

As the feed enters the jig, separation of coal and refuse begins immediately in No. 1 cell, with some refuse being hutched through the bed plate. Separation of refuse and coal continues in No. 2 cell, where more refuse is hutched through the bed plate. The refuse thus hutched from No. 1 and No. 2 cells is conveyed back to elevator No. 1, located on the feed end of the jig, which dewaters and delivers the refuse to the primary refuse conveyor leading to the main refuse bin outside of the plant.

From No. 1 and No. 2 cells the partly cleaned coal passes to No. 3 and No. 4 cells successively, from which a middling product is hutched and removed by screw conveyor and dewatering elevator, and is then returned by flight conveyor to the feed end of the jig, where it is added to the jig feed for rewashing. The cleaned coal is carried over the end of No. 4 cell, which is the end of the jig, by the wash water, and flumed to the cleaned fine coal settling tank.

Control of Pulsion Intensity

The first type of automatic control tried out on this jig was one devised and tested by McNally engineers in the factory during construction of the jig. This device, termed by McNally as "sensing tube" control, consisted of a one in. diameter stainless steel tube suspended vertically into the bed of each cell with the bottom end being just above the level of the false bed. The operation of this control depended upon the pumping action in the bed to raise the pressure in the tube, which pressure was transmitted through a copper tube to a Minneapolis-Honeywell Pressuretrol device which actuated a rheostat, which in turn produced a forward or reverse motion to a Modutrol motor, depending on the density of the cell bed for proper pulsion demand.

This device would work fairly well for short periods, but not continuously, even with close manual attention. Aside from that resulting from faulty designed valves, the principal cause of trouble with this device was the frequent blocking of the lower end of the tube with middling solids and/or wood chips. Various means

of preventing this trouble, including injection of air at the lower end of the tube, addition of clear water at the upper end of the tube, and other means, were tried with little or no success. Finally, after many weeks of disappointing results, the device was abandoned as being impossible of perfection.

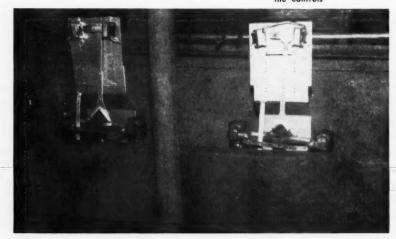
Following discarding of the "sensing tube" control, a standard float control, which, incidentally, was also furnished by McNally, was installed in No. 1 cell of the jig. This control consists of a cylindrical metal float placed above the false bed through linkages causing movement of an iron core through coils. The position of the iron core, in the coils, determines the direction and degree of opening of the pulsion valves by varying the impedence to a Modutrol motor, depending on the density of the cell bed positioning the float. This control, although it appeared to actuate the pulsion with more sensitivity than the "sensing tube" device, was found to be incapable of giving consistently dependable results, and thus failed to fulfill even the minimum requirements of a fully automatic control. Hence, after several weeks of more or less unsatisfactory results, it was discarded and replaced with a control designed and built by our own staff. This device, a sub-sieve float control mechanism, appears to be the solution of our problem. It is the same in principle as that employed on our Vissac pulsator jigs, but differs in the manner of integrating the float mechanism with that of the refuse extractor

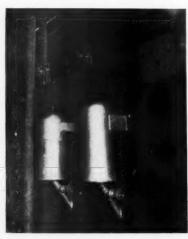
As presently installed, this device consists of a standpipe, made of 12 in. diameter steel pipe, 32 in. long, mounted on the outside of the jig and connected to the latter by means of a two-in, pipe inserted and welded into the side wall of the jig at a point about six in. below the level of the bed plate. A float in the standpipe rises or falls depending upon the density of the bed. This motion of the float is translated through delicately balanced beams and a vertical pendulum on which is mounted an iron core that swings in and out of two impedence coils, which in turn are electrically connected with the Modutrol motor that actuates the refuse extractor.

Further, as originally designed and furnished, the jig had a rated capacity of 75 tph, whereas the actual load was found to run only about 40 tph, at times as much as 45 tph. Hence, in order to accommodate the jig capacity to the normal load, the width of the washing compartment of the jig was reduced from 6 ft 6 in. first to three ft, and subsequently to four ft. This was accomplished by building in false linings, first 21 in. wide and later 15 in. wide, on the inside walls of the washing chamber. Also, in order to better regulate the reduced quantity of water required, the original five-in. valves, one on each cell, were replaced with two-in. valves. The latter have proved ample in size.

Having once determined the proper settings of the counterweights on the control beams, and the water supply valves, no further adjustment of the controls is normally required for the

These two side views of the jig show the automatic controls on cells No. I and 2. A float in the standpipe rises or fells, depending upon the density of the bed. This motion of the float is translated through delicately balanced beams and a vertical pendulum on which is mounted an iron core that swings in and out of two impedance coils, which in turn are electrically connected with the Modutrol motor that actuates the refuse extractor. In an effort to improve the device, consideration is now being given to the idea of substituting for the present electric mechanism some kind of hydraulic means of actuating the controls





particular coal being treated. These settings, which necessarily must be determined by cut-and-try method, are made with the objective of producing the maximum possible yield of coal of the desired ash content, and at the same time, producing a refuse product with the minimum possible proportion of saleable coal.

Results of Tests

Table I gives a summary of the results of a full day's test of the jig on the ¼-in. to 48 mesh No. 5 (Roslyn) bed coal from No. 9 mine. These results are typical of the performance of the jig as presently adjusted. It will be noted, incidentally, that the washed coal product runs lower in ash than the raw coal (feed) float on 1.59 sp gr-10.7 percent as against 13.3 percent. This means, of course, that the jig is actually washing at a lower gravity than 1.59. These results are considered very good.

Table II shows the results of several hours' test of the jig on the 1/4-in. to 48 mesh No. 1 bed coal from No. 3 mine. These results also are typical of the normal performance of the jig as presently adjusted for this

TABLE I. Summary of Results of Test Made on 1/4-In, to 48 Mesh Roslyn No. 9 Mine Coal-No. 5 Bed.

FEED			
	1/4 - In. to 20 Mesh	20 to 48 Mesh	Composite 1/4 · In. to 48 Mesh
Screen analysis, percent by weight	73.2	26.8	100.0
Ash content, percent	24.0	25.8	24.4
Float on 1.59 sp gr	60.1	21.2	81.3
Ash content of float	. 12.8	14.7	13.3
Sink in 1.59 sp gr	. 13.1	5.6	18.7
Ash content of sink	75.1	67.8	72.9
WASHED (COAL		
76.7 Percent of Feed			
Screen analysis, percent			100.0
Ash content, percent		1.4 8	10.7
Float on 1.59 sp gr			98.3
Ash content of float		7.4.4	10.0
Sink in 1.59 sp gr			1.7
Ash content of sink			54.8
REFUS	E		
23.3 Percent of Feed			
Screen analysis, percent			100.0
Ash content, percent			67.2
Float on 1.59 sp gr	. 8.0	8.5	16.5
Ash content of float	. 27.9	15.9	21.5
Sink in 1.59 sp gr			83.5
Ash content of sink		100	76.2

coal. The latter is not only a dirtier coal than that from No. 5 bed but is also, because of its high content of intermediate gravity material, a much

more difficult coal to wash effectively.

Table III presents a summary of the results of a full day's test on 14in. to 48 mesh No. 1 bed and No. 5 bed blend-normally 1 to 1-from No. 9 mine. These results would indicate, however, that the blend, at least during the period of this test, carried a considerably greater proportion of No. 5 bed coal than No. 1 bed coal. It is possible also that these results reflect a variation in the character of No. 1 bed coal at No. 9 mine from what it is at No. 3 mine. Neverthe-

Improved Control Sought

considered very good.

less, the jig performance data are

As stated above, the feldspar jig is not new in coal cleaning practice. It has been used widely and successfully in Europe for years mainly by reason of the development of reliable automatic controls for its operation. Conversely, it has failed of acceptance in America largely because of the lack of a fully automatic control for its operation.

The control, as presently developed and installed on our jig at Roslyn, comes close to being a completely automatic and a fully satisfactory control. However, it, like most mechanical devices, is not 100 percent perfect, or trouble-free. The one apparent weak point in the presently developed device is the infrequent, but ever present, possible mechanical failure of the control to function because of fouling and consequent sticking of the electric contactors. For this reason, therefore, consideration is now being given to the idea of substituting for the present electric mechanism some kind of hydraulic means of actuating the controls. Whether or not this will improve the device only time and testing will tell.

TABLE II. Summary of Results of Test Made on 1/4-In. to 48 Mesh Roslyn No. 3 Mine Coal-No. 1 Bed

FEED		
* *******	Weight	Ash
Float on 1.59 sp gr, percent Sink in 1.59 sp gr, percent	51.5 48.5	18.3 66.1
Composite	100.0	41.4
WASHED COAL		
54.0 Percent of Feed		
Float on 1.59 sp gr, percent	89.9	15.1
Sink in 1.59 sp gr, percent		51.5
Composite	100.0	18.8
REFUSE		
46.0 Percent of Feed		
Float on 1.59 sp gr, percent	6.4	23.2
Sink in 1.59 sp gr, percent		75.4
Composite	100.0	72.0

TABLE III. Summary of Results of Test Made on 1/4-In. to 48 Mesh Roslyn No. 9 Mine Coal—No. 1 and No. 5 Bed Blend

FEED		
	Weight	Ash
Float on 1.60 sp gr, percent	73.3	11.6
Sink in 1.60 sp gr, percent	26.7	71.9
Composite	100.0	27.7
WASHED COAL		
70.7 Percent of Feed		
Float on 1.60 sp gr, percent	97.6	10.6
Sink in 1.60 sp gr, percent	2.4	46.1
Composite	100.0	11.5
REFUSE		
29.3 Percent of Feed		
Float on 1.60 sp gr, percent	14.6	27.0
Sink in 1.60 sp gr, percent	85.4	73.6
Composite	100.0	66.8



Plans for the 1958 Coal Convention in Cincinnati next May 5-7 were outlined by this committee of industry leaders

1958 COAL CONVENTION

Union Chief to Make Luncheon Address

ON November 13 the Program Committee for the 1958 Coal Convention held a meeting in Pittsburgh to select topics and speakers for this year's largest industry affair, to be held in Cincinnati next May 5-7. James C. Gray, vice-president, coal operations, U. S. Steel Corp., and National Chairman of the Program Committee, presided over the 50 representatives of mine operators and equipment manufacturers in attendance.

"Research for Progress" was the theme selected for the Convention. The Committee felt that this theme reflects a highly important aspect of the industry which has come sharply into focus in recent years. The entire Convention Program has been designed to report in detail recent advancements in coal mining technology and safety.

Suggestions for papers covering all

phases of deep and strip mining, as well as coal preparation and safety, were carefully reviewed in drawing up the program. A primary source of Convention topics was a compilation of questionnaires circulated throughout the industry asking for subjects of major importance to coal mining men and the names of men qualified to discuss them. An outline of the sessions to be held at Cincinnati is given below.

For the Convention in May, two special luncheons have been arranged. Guest speaker on Monday, May 5, will be John L. Lewis, president of the United Mine Workers of America. This is the first occasion on which Mr. Lewis has addressed a national convention of this type, and his remarks will be received with the greatest interest. Mr. Lewis will be introduced by George M. Humphrey, Chairman, National Steel Corpora-

tion and former Secretary of the Treasury.

At the Tuesday luncheon a well-known authority in a nontechnical field will be heard.

In addition to a full schedule of morning and afternoon business meetings, the evenings will be busy also. The famous Coal Miners Party is scheduled for Monday evening. All who have attended this festive event in the past know how much fun it can be. Tuesday night will be left free for "mining coal" with old and new friends. A banquet is scheduled for Wednesday night as a fitting conclusion for what is shaping up to be a Coal Convention of particular significance to the industry.

It is not too early to make arrangements to attend the Cincinnati meeting next May. Write directly to the hotel of your choice in Cincinnati for accommodations.

Outline of Sessions

MONDAY MORNING

Research for Progress

MONDAY AFTERNOON

A: Strip Mining

B: Undeground Power

TUESDAY MORNING

A: Coal Preparation

B: Safety

TUESDAY AFTERNOON

A: Mine Haulage

B: Continuous Mining

WEDNESDAY MORNING

A: Conventional Mining

B: Coal Preparation

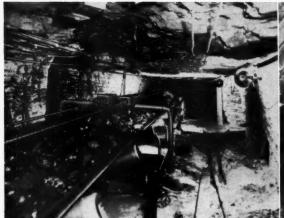
WEDNESDAY AFTERNOON

A: Continuous Mining

B: Strip Mining

MAJOR FACTORS IN BELT CONVEYOR HAULAGE

Proper maintenance, including accurate record keeping, is of prime importance in maintaining conveyor efficiency





Left—To protect this conveyor belt against roof-falls, lengths of wire rope were strung above the belt, their ends joined to coiled springs that connect into electrical relay boxes. If a section of roof falls onto the belt, it pulls the wire rope taut as it strikes. The connecting springs trigger the relay, which shuts down the drive motor. Damage is thus held to a minimum. Right—Output of Pittsburgh Consolidation Coal Company's Mine No. 9 is carried to the surface on a slope belt conveyor having a 1468-ft center-to-center length. The belt is 42 in. wide and can carry 600 tph up the 405-ft lift of the slope

By ROBERT E. SPOERL

Chief Belting Sales Engineer United States Rubber Co.

THE last 30 years have seen belting come from zero utilization in coal mining to its present position as the hub of the haulage that handles United States mining output.

The impetus in the use of belt conveyors has been based strictly on economic necessity. After World War II, coal production fell from 600,000,000 tons to 392,000,000 tons—the lowest level since 1939. At the same time, natural gas and oil production

skyrocketed so that, for the first time in history, our nation obtained more energy from oil than from coal. In addition, the coal operator's costs were increasing. The challenge was clear-if coal was to keep its preeminent position as the most economical and versatile source of power, it would have to mechanize all phases of its operation. New methods all down the line, including new techniques of cutting, blasting and loading, and the advent of the continuous mining machine, have brought the expected results. Tonnage is again at very high levels.

It is interesting to note that almost half of this tonnage is produced by only 270 mines or three percent of the 9000 active mines in the country. The trend toward consolidation of resources and operation has increased the efficiency of mining so that today coal is again meeting the sharp competition of other fuels.

Advantages Include Continuous Haulage

What are the advantages of belt conveyors which fit so perfectly into the new look in coal mining?

Probably the most obvious feature of a belt conveyor is that it is a continuous haulage machine. Coal can be removed from the face as quickly as it is mined, thereby eliminating delays for loading and unloading and empty return runs.

Conveyors have a very wide range



The adaptability of belt conveyors to unusual applications is demonstrated by this suspension-bridge belt conveyor. The material flows without interruption from a loading hopper across a highway and river, and discharges directly into a storage yard at a power plant

of capacities. The tonnage delivered depends only on the belt width and speed and the weight of the coal. Run-of-mine, screened product and rocky overburden can all be handled with equal facility. The abrasion resistance of rubber is at the top of the scale of all materials commercially used to fabricate haulage components. Temperatures over 100° F or below zero, rain, sleet, snow or poor visibility do not hamper its operation.

This type of haulage can follow level or pitching terrain with equal ease. Grades up to 30 percent can be handled by a belt line, while locomotives are limited to grades between two and three percent and trucks and shuttle cars to ten percent. Hauling out of the open pit, traversing winding hilly countryside, threading along pitching underground seams, the belt conveyor offers the same sure swift flow of coal. Belt lines give straight line haulage which in many actual cases have saved thousands of feet of distance as compared with alternate methods which might include narrow gage slope trackage, shaft hoists and surface rail haul. Belt systems can also turn right angle corners.

For all practical purposes, the distance belting can convey coal is unlimited. Newly developed high tension fabrics make possible single flights over three miles long. Any

distance can be spanned by using a series of conveyors in tandem. Belt lines about ten miles long have been used in several dam construction projects, lending the coal-mine operator valuable data on which to base future long-distance overland coal transport.

On the surface or in the strip pit. belt conveyors require little preparatory construction and erection. Underground, they allow the use of a simple right-of-way, narrow entries and low headroom. No tracks have to be laid or trolley wires strung. Little grading is necessary and no ballast, and often simple roof support can be used. In many underground mines, the speed with which coal is removed from the working face means that roof support has to be maintained for a shorter time. The reduced time factor has cut timber. chock repair and replacement costs as much as 15 percent.

As for low headroom, belt conveyors hold a unique position in the recovery of thin-seam coal where driving an entry to accommodate other means of haulage would make the operation economically unfeasible.

Since supporting structures and the conveying equipment itself is light-weight, load-per-foot is extremely low when compared to the volume of coal carried, thereby permitting its use in

poor bearing areas. And if it is necessary to span a ravine or cross a river or highway, the conveyor belt bridge is the lightest, narrowest and most economical.

Belt haulage is smooth, silent, continuous. Freedom from vibration allows use of bad-roof areas and greatly reduces the dust problem at the face and along the panel. Where lump degradation is important, the smooth transfer and transport of coal on a belt reduces breakage. You may recall H. C. Frick's Colonial Dock egg experiment where two dozen eggs, packed in standard chipboard cartons, were placed on the coal laden belt near the mine end. After traveling over four miles and going through 18 transfer points, the eggs arrived at dockside with only five eggs cracked in one carton and none at all cracked in the other. The quietness of the operation also contributes substantially to the reduction of personnel fatigue and irritability.

Belt haulage provides the lowest power consumption with a uniform power factor. Descending belts in which the gravity pull exceeds the frictional resistance can be so designed that the motor acts as a generator and power is put back into the electrical transmission system so that it can be used elsewhere.

Since the coal does not come in contact with any of the moving metal parts of the conveyor, wear is low and troubles are few. In properly designed conveyor systems, only one man is needed to operate and maintain one mile of belt line. Bearing lubrication is necessary, on the average, of once every six months. Belt installation, although requiring exactness, is a simple procedure and production downtime is held to a minimum.

No other transportation system affords such safe operation as belt haulage. Its direction of motion is completely predictable so collision accidents are eliminated. There are no switching, shunting or coupling accidents, or runaway cars in pitching seams. Since all of its machinery is stationary, it can be readily enclosed in protective housings. Bare trolley wires are eliminated. Belts can operate untended in hazardous locations and shrinking entries, keeping personnel out of danger zones.

Properly maintained belts very rarely suffer a sudden breakdown. The belt itself signals its need for replacement in ample time to have a standby belt ready for installation.

Fire hazard can be eliminated by the use of neoprene fire resistant belting.

Belt haulage would not have widespread useage unless it had amply demonstrated its low cost per ton of coal carried. Although a study of the initial cost of the haulage system shows that conveyors are often the most economical medium of transport because of the reduction of grading, elimination of intricate haulage ways and the simplicity of roof support, the long term savings which result from lower maintenance and extremely long service life put the belt conveyor in an extremely low cost per ton position.

Selection of Proper Design

It is necessary to transfer all of these inherent advantages into practical specifications for specific applications. It isn't possible here to detail the economic factors which would govern the choice of the best belt conveyor, but it might be well to point out some general considerations which usually must be dealt with.

In respect to belt width, it is always the most economical to select a belt which will be fully loaded. In addition to minimizing horsepower requirements, there will be less wear for a given tonnage conveyed.

Belt speed can be varied widely but is most often in the 350-600 fpm range. Wider belts can be run faster than narrower belts and light material can be run faster than heavy material. At a given tonnage, a fast belt can often have a less expensive construction than a slow belt, but, on the other hand, it will also cycle faster. In other words, it will pass the loading point more often so cover wear will be accelerated.

Belt conveyor length is most often dictated by the total distance you wish to move the material. However, on some very long runs or high lift slopes, there is often the choice of conveying the load in a single or multiple flights. A single long conveyor has no transfer points and eliminates the problem of installing intermediate drive machinery. In addition, there is less wear on the belt cover because of less frequent loading per foot of belt length, meaning that replacement will not be required as

However, the multiple flight system allows the use of a lower tension belt carcass and savings in initial belt cost. It uses more but less expensive pulleys and multiple motors and reducers are sometimes less expensive than a single large drive machinery unit of the same total horsepower rating.

Suffice to say that the best choice must be based on a careful analysis of relative costs of investment, installation, amortization and maintenance. Your machinery or belting supplier will be able to assist you in the selection of the proper design.

Maintenance and Service Records

Even after a well designed belt conveyor is installed, there are two things which must be done to make it



This 2000-ft long installation at the Will Scarlet mine is one of the country's longest belt conveyors used in a coal strip-mining operation. The loading hoppers are semi-portable and can be relocated at any point along the conveyor as required by the mining plan. A 330-ft inclined belt conveyor at the end of the run lifts the coal 50 ft to the top of a stacker from which it is transferred by chute to the storage pile

operate at top efficiency—one is proper maintenance and the other is accurate records.

If we were all motivated by purely economic considerations, we would all practice more efficient maintenance. However, few of us like to go out and look for trouble, but that is exactly what is necessary when practicing good preventive maintenance.

It is important that the operator does not consider his belting as an expendable item—no one can afford such an expensive indulgence. Simply because the conveyor haulage system is so dependable and does not require servicing every shift or day, this does not mean that common sense preventive maintenance, good houskeeping, properly designed loading equipment and routine belt repairs should be overlooked.

A major conveyor installation represents a sizeable capital expenditure and should be maintained and inspected with the same diligence that is applied to mining machinery, crushers and rolling stock.

Proper selection of personnel are very important to proper maintenance. In spite of the job description or assigned duties of your belt haulage maintenance people, the quality of the maintenance will be only as good as the qualifications of the personnel assigned to the job. Select these people carefully—they are important to your successful operation.

In order to get the maximum tonnage hauled per dollar innvested, it is also necessary to maintain accurate belt service records. Accurate records are the backbone of every sound business venture. Efficient belt line operators keep these records to provide tonnage and cost per ton analysis, which may mean the difference between future profit and loss. True belt cost cannot be determined until the belt is removed. You may then find that a high priced belt which gave long service is more economical than a low priced belt which had a short life. Records allow your belt man to predict tonnage and help him to head off trouble and work out an effective inspection-maintenance schedule. Further, these records are a major aid in proper belt selection because they will indicate changes which should be made in a replacement belt.

Coal Mining's unwanted holiday is over. Coal is meeting the world's expanding power needs and belt haulage is keeping apace. Select your belt system carefully, maintain it properly and it will afford you high tonnage transportation, safely, continuously and profitably.

Kings Mountain

LITHIUM

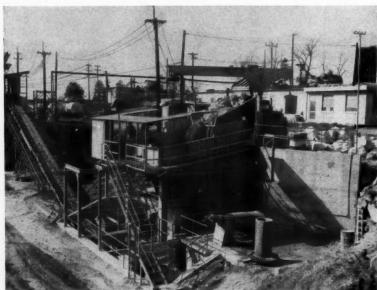
Mining Operations

Growth of lithium industry in recent years has been extraordinary. Here is a report on the development of the Kings Mountain area in North Carolina, our country's largest proven lithium ore reserve. Foote Mineral Company's long-range exploration drilling program, the present work on a 200-ft deep open-pit mine and future mining plans are all described

By NEIL O. JOHNSON

Manager

Foote Mineral Co.



Fortunately, from a mining and milling standpoint, the ore deposits of Kings Mountain are homogeneous and nearly uniform in grade throughout the dike

LITHIUM has in recent years emerged from a minor role in the metal world to become one of its glamorous stars. Not too many years ago it was a metal curiosity. Like the majority of other metals, it is always found in nature chemically combined with other elements. Much of lithium's present uses are classified; however, there is every reason to believe that it will be no short term wonder in the mining industry.

Lithium is thought to have been first produced in the metal form in 1855 by Robert Bunsen, the inventor of the Bunsen burner. It is not only the lightest metal but one of the lightest solids. It has a density of 33 lb per cu ft which makes heavy-weights out of the now familiar light-weight metals such as magnesium and aluminum which have densities of 108 and 162 lb per cu ft respectively. As a structural metal, lithium is of no value in that it will cut like cheese and reacts vigorously with water at room temperatures. The heat of a match will melt it, yet it takes 2550°



Spodumene deposits in the Kings Mountain area are the largest in operation in the United States and are believed to have the greatest economic value of any in the world

F to boil it. This wide liquid range offers possibilities as a heat exchange medium between nuclear reactors and steam generators in the production of electricity.

Has Many Uses

The growth and use of lithium has been phenomenal in recent years. As late as 1942 there were only two significant applications; (1) as a hydride in air-sea rescue kits, and (2) as the hydroxide for the production of multipurpose greases. The nuclear application of lithium is, of course, classified, but there are some nuclear physicists that have publicly announced that lithium-six will be used in the process of generating power by controlled fusion reactions. During World War II lithium was placed under the control of the War Production Board, with the government siphoning off nearly the total production. The result was that lithium lost many of its industrial outlets so when the war ended and government demand ceased, the production of lithium ore dropped drastically in 1945.

Multi-purpose lithium base greases developed during the war are now licensed to 30 major oil companies whose industry accounts for approximately 30 percent of the current lithium production. The extensive use of lithium in lubricating greases is based on four properties: water insolubility, high melting point, gel forming characteristics and lubricity of lithium soaps of fatty acids. When a lithium soap is used, the resulting grease is soft enough to flow at low temperatures and has little or no change in consistency with a change in temperature. It also does not emulsify with water. These combinations of properties have made possible the manufacture of multi-purpose greases for industrial and automotive applications. It would be interesting to speculate on the outcome of the Nazi-Russian campaign had the lithium base greases been available to lubricate the German armor and transport vehicles. Interrogations of the German Army military leaders after the war indicated that one of the biggest factors in the failure of the Russian cam-

paigns was the mechanical breakdown of their armor due to the extreme cold.

The porcelain enamel and glass industries are the second largest consumers of the lithium compounds where its principal use is as a flux. When used in this way, lower firing temperatures are obtained with the enamels having improved acid resistance and greater resistance to thermal shock. In the television tube industry, lithium base glasses have replaced the older lead base glasses at a 50 percent saving in batch costs. In the metal industry, lithium salts are used in fluxes for welding and brazing, particularly aluminum. Should aluminum replace copper in radiators, this application could cause substantial growth in the lithium market. Lithium is also used as a degasifying or purifying agent in producing sound aluminum, lead and copper castings. Tests indicate that lithium in amounts up to 71/2 percent in aluminum and 13 percent in magnesium can be added to pure molten metals.

A large part of the current lithium production finds its way into the air conditioning field because its compounds have excellent hygroscopic properties. Air to be conditioned is brought in contact with lithium halide solution, where moisture can be either added or removed to maintain the desired relative humidity. Lithium is also found in the form of solutions used in the cooling systems of refrigerating gases. These solutions have a high absorption capacity for many of the gases including ammonia and chlorinated organics. Systems of this type have the advantage of being completely sealed and free of moving parts and have a high degree of reliability and long life.

One of the first uses of lithium was in the alkaline type of storage battery where it is employed in the cells of the so-called Edison nickel-iron storage battery. The high electrical conductivity of its chlorides and bromides together with its low freezing point make it a desirable component of the dry cell type battery, allowing it to function at temperatures as low as minus 40° C. Anhydrous lithium

hydroxide is useful as a carbon dioxide absorbent for gas masks and in submarines. It is also used to control the formation of alkali resins in paints.

Types of Deposits

Lithium is a widespread element, making up approximately 0.006 percent of the earth's crust. Known concentrations of economic importance, however, are not common and are limited to two types; namely, salts in brines, and lithium-bearing minerals in pegmatites. The natural brines found in warm arid regions consist of a complex alkali containing sodium and potassium chlorides, borates, carbonates, and sulphates with lithium being a minor constituent. Here the lithium content expressed in percentage is very low (about 0.015 percent Li₂O), but where the deposits are large, lithia may be present in a sufficient volume to justify recovery. The only such deposit now being worked is located at Searles Lake where the lithia is recovered as a by-product.

In the mineral form, lithium is most commonly combined with aluminum silicates and phosphates, and with few exceptions, is confined to pegmatites. These are coarse-grained, dike-like ore bodies, composed of feldspar, quartz, mica, and often one or more

Following graduation from the Colorado School of Mines, Neil O. Johnson worked a short time on the Twin Lakes
Water Tunnel near



and initial operations of metallurgical and chemical processing equipment throughout the United States and Canada. In 1939 he joined the Explosives Dept. of Du Pont Co. and served as technical representative until 1956, when he accepted a position with the Foote Mineral Co.

of the rare minerals. Although lithium has been known to be a constituent of some 145 known minerals, there are only four-namely, spodumene, amblygonite, lepidolite and petalitewhich are considered as being of commercial importance. Spodumene crystals are lath-like, are white to pale green in color and contain 6.5 to 7.5 percent lithia (Li2O). A deposit is considered to be of potential economic importance if the lithia content averages between 1.2 and 1.7 percent Li₂O. In the United States, spodumene, amblygonite and lepidolite are the chief lithium minerals, all of which are present in the pegmatites of North Carolina. However, only spodumene has been found in commercial quantities.

Geologically these pegmatites, which originated as a molten magma deep within the earth, were forced upward by tremendous pressures through the fractures in the adjacent rocks. In cases of rapid cooling, segregation of the minerals was prevented and a homogeneous composition was formed. In cases of slow cooling precipitation of the mineral occured in stages, first along the walls of the fractures and then successively inward forming a zoned pegmatite. Fortunately, from a mining and milling standpoint, the ore deposits of Kings Mountain are homogeneous and nearly uniform in grade throughout the dike. No hand cobbing, the usual practice for mining pegmatites of this type, is necessary.

Currently the United States has the largest proven lithium ore reserve and is the major producer and consumer of lithium in the world. According to a recent North Carolina State geological bulletin, the State contains nearly 93 percent of this country's reserves. Most of these are centered in the Kings Mountain area. Sources other than the tin-spodumene belt of North Carolina are the brines of Searles Lake, Calif., and the ores of the Black Hills in South Dakota. Lithium deposits also occur in Arizona, Colorado, New Mexico, Wyoming and the New England states, but mineable reserves in these states are limited. Foreign ore from Canada and

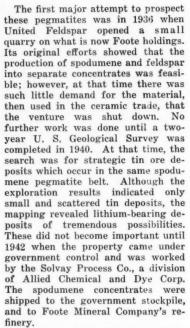
Africa are of increasing importance to the domestic industry since, of the three major lithium producers in the United States, only Foote Mineral Co. mines its ore domestically.

Earliest production in the United States goes back to 1880 at which time gem spodumene (hiddenite) was mined near Stony Point, N. C. From 1900 to 1917 lithium ore production was very small and erratic, averaging 581 tons per year. Between 1918 and 1920 it amounted to 6500 tons and increased to a maximum of 11,696 tons in 1920. In 1945 production dropped to 2446 tons and in 1952 it was again up to 15,611 tons. Since 1953 production figures have been classified.

Selective Mining Necessary

Mining in the Kings Mountain area started in the early 1900's when deposits of an unknown and unique mineral identified as topaz were discovered. In 1906 a geological survey correctly identified this mineral as spodumene. However, the discovery caused little excitement or interest, since no commercial market existed for the mineral and there was virtually none for lithium chemicals. The spodumene bearing pegmatites occur in a belt 25 miles long by 1.8 miles maximum width extending from Grover, S. C. to Lincolnton, N. C. Here the elevation is 900 to 1000 ft above sea level and the strike of the pegmatites is northerly with slight dips toward the west. All known drilling to date indicates that the largest concentration of pegmatites is located on Foote's property approximately 11/2 miles south of the City of Kings Mountain, N. C.. Here a series of large parallel dikes are concentrated making possible an open pit operation of approximately 1000 ft in width. Selective mining is necessary in order to separate the waste rock, consisting of mica schist, gneisses and amphibolite between the pegmatite dikes. The ore dikes are composed primarily of feldspar and quartz with approximately 20 percent spodumene, 8 percent mica and small quantities of beryl and other scarce minerals.

> Currently 20-ft benches are used because they offer efficient and safe working conditions, especially where selective blasting and mining of ore and waste are necessary



Foote Mineral Co. first entered into the lithium business when it began buying amblygonite ores from the Dakotas together with lepidolite and other lithium minerals from foreign countries. These were converted into a variety of lithium chemicals. In 1951 Foote acquired the Kings Mountain ore deposits from the Solvay Process Co. and began plant operations the same year, using facilities then on the property.

Long-Range Drilling Program

Prior to Foote Mineral Co. taking over the property, little prospecting was done by the Solvay Process Co. except for several inclined diamond drill holes drilled in 1943-44. From then until 1950 no further core drilling was done in as much as the property remained inactive from 1945 to 1950. Foote's purchase of the Solvay lease was based to a large degree upon the pre-war geological survey together with the meager Solvay Process Co. drilling. After Foote took over the property, it began a long-range drilling program which lasted two years (1954-56) and which proved very successful in that 40 percent of all footage drilled was in ore. Obviously the pre-war U. S. Geological Survey shortened the time of locating and exploring the overall deposits. This exploration program, under the direction of T. L. Kesler, the company's chief geologist, consisted of drilling a systematic pattern, using a company owned and operated core drill. The general drilling layout was to place the holes on 80-ft intervals along a line at right angles to the strike of the deposit. These lines of holes were 160 ft apart. Except for nine 45°



angle holes, all drilling was vertical using primarily AX core bits. The drilling rate averaged 35 ft per 8-hour shift with 100 percent core recoveries in the pegmatites and 70 percent core recoveries in the country rock. To cover the maximum area, in the limited amount of time available, most of the holes were drilled under 600 ft in depth.

Core data were transferred from the cross sectional log maps onto plastic plates which were then inserted into a glass encased mine model having a scale of 40 ft to the in. This presented a three dimensional view of the irregularities of the pegmatite dikes from which a longrange open-pit mining operation could be planned. Having proven ore reserves of 13,400,000 tons in this area, the current program is to first develop a 200 foot deep open-pit mine. This ten-bench plan should take 15 years to complete and, since core drill data extend well below this level, the second phase of development will probably use inclined skips to operate a 400-ft deep pit. Beyond that point, future mining plans will be either the development of the pegmatite dikes to the south by open-pit methods or going underground. Currently 20-ft benches are used because they offer efficient and safe working conditions, especially where selective blasting and mining of ore and waste are necessary. These pegmatite dikes, which are essentially parallel to each other, ranging from 10 to 200 ft in thickness, have irregular strikes and shapes, making selective open-pit mining imperative. If this same formation were to be mined underground with full ore recovery, a square set timbering method of stoping would likely be required because of the weak waste wall-rock.

The Mining Method

The pit benches are developed by entering the southeast corner with a 175 ft wide slot driven westward across the strike of the ore dikes, removing the ore and waste respectively as encountered. When the slot reaches the western limits of the pit area, mining begins on the north wall by first removing the waste on either side of the exposed dikes, followed by mining the exposed ore, then going back to waste, etc. Thirty ft wide bench roads are left on each level since the amphibolite and clay stringers will not stand well enough to form vertical walls of great height. It is expected that as lower horizons are reached, steeper pit walls can be maintained.

Drilling is done with four D-99 Gardner-Denver wagon drills, three of which are mounted on Air Tracs. All drills use 8-ft, 1½ in. diam sectional steel. Air to the drills is furnished by one 1300 cfm stationary compres-



Having proven ore reserves of 13,400,000 tons in this area, Foote Mineral Company's current program is to first develop a 200-ft deep open-pit mine. This ten-bench plan should take 15 years to complete and, since core drill data extend well below this level, the second phase of development will probably use inclined skips to operate a 400 ft deep pit

sor. A 535 cfm stationary compressor is available on standby basis as needed. Air is carried along the west and south sides of the open pit in sixin. air lines. From here four-in. lines, using victaulic couplings, carry the air into the pit and near the area being drilled. A driller operates each drill with a helper servicing two drills. The holes are drilled 24-ft deep, using a 6-ft spacing by 5 ft burden in the ore and a 7-ft spacing by 6-ft burden in the waste. Holes are drilled in the conventional staggered pattern with an occasional snake hole included in the blast. Drilling speeds average approximately 35 ft per hour in the ore and 40 ft per hour in the waste. Tungsten carbide 21/2 in. diameter bits are used for drilling, and footages are closely recorded since the cost per foot of hole drilled is of primary interest. Various types of bits have been tried with footages ranging from 100 to 300 ft per bit. Approximately twice as much bit footage is obtained in the waste as in the abrasive ore which has an approximate hardness of quartz. One development recently noticed was that better footage per bit was obtained using track-mounted drills rather than rubber-tired equipment. Better stability, sectional steel and larger blowing capacity probably account for part of this.

Blasting is done with 40 to 60 percent ammonia and semi gelatine dynamites except in ragged holes where free running types of explosives are being tested. The average blast is composed of approximately 110 holes containing 2500 lb of explosives distributed in eight rows. Explosive ratios range from two to four tons per lb, depending whether in ore or waste; the overall ratio averages 2.8 tons per lb. Although some two in. diam cart-

ridges have been used, the standard size is 11/2 by 12 in. Holes are bottom initiated by either a 220 volt a-c power line or a duPont CD-48 condenser type blasting machine using 24-ft millisecond delay blasting caps ranging from 25 MS up to 400 MS. Caps of this type are used for the following reasons: (1) they improve the fragmentation, (2) control the throw of either the waste or the ore, a very important factor in selective mining operations, and (3) reduce ground vibrations which are checked occasionally with a recording seismograph. Air concussions are also closely controlled with six to eight ft of stemming on primary blasting and using a dropball for secondary break-

Ni-Hard dropballs have recently replaced the forged steel balls which are purchased at approximately 10,-000 lb and are worn down to 5000 lb. Used shovel cables of one in. diam are employed for connecting the dropball to the heavy duty swivel at the end of the cable. A high tensile strength chain has been tried; however, used cable is more economical. The dropball is operated from a 11/2-yd Osgood rubber-tired standard mobile crane equipped with a 60-ft boom which operates closely behind the shovels loading ore, breaking approximately 130 boulders per 8-hour shift. This rubber-tired unit moves between the two production benches and is also used by the maintenance and the construction departments when needed.

Three 1½-yd diesel powered shovels, (two Bucyrus and one Northwest) are used in the open pit. Two handle waste and one loads ore. Because of the selective mining method, these 1½-yd shovels are well adapted for this type of work. Large boulders of

ore are cast to one side where they are broken with the dropball after which the ore is loaded into ten-ton Euclids. Waste is hauled in 15 and 22-ton Euclids. Due to the abrasive ore, spare buckets are built up constantly. Adapters and box points are used on the buckets with the adapters being built up two or three times before being discarded. Box points are replaced nearly every week. Except for welding and electrical service, the shovels are maintained by the operators. An oiler is assigned to each machine who assists in minor repairs and clears the roadway of any large boulders that might cause tire damage.

Nine rear dump Euclids are used; three are ten-ton units for hauling ore, five 15-ton units and one 22-ton unit haul waste. The 10-ton and 22ton Euclids are equipped with General Motors engines, while the 15-ton Euclids have Cummins motors. Haulage distance from the center of the pit to the waste dumps is approxi-mately 2200 ft. The haulage roads are maintained with a power-operated motor patrol; grades are 12 percent with some short distances up to 15 percent. As deeper levels are opened up, grades of 15 percent will be needed. Two D-8 bulldozers maintain proper dumping conditions at the waste dump, clean-up in the pit and do other general plant work.

Other equipment includes a %-yd front end loader for miscellaneous hauling in and around the plant area. A 1½-ton flatbed truck equipped with a fuel tank and grease guns services the shovels, trucks and bulldozers. Another 1½-ton flatbed is available for hauling spare parts, pipe and other items needed by the mining crew. A %-ton pick up truck with

rack type body is used by mine foremen for hauling powder and general supervision. A 2000 gal capacity water wagon is pulled by the motor patrol to wet down the roads during the dry season. To furnish illumination for the evening shift work, floodlights mounted on standard light poles are installed on two sides of the pit. Dropcords from these poles are strung to portable light stands at each of the four wagon drills. The shovels and the Osgood dropball machine have individual gasoline driven 110-volt light plants mounted on each machine.

Good Maintenance Essential

All equipment repairs are under the direction of the plant engineer who heads up the engineering and maintenance department. A vehicle maintenance foreman is directly responsible for the maintenance of all vehicles and maintains inventory control to keep these units in operation. An extra diesel engine for the 10 and 15ton Euclids is on hand for spares as needed. At the present time a series of oil sample tests are being made on individual equipment for the purpose of determining the optimum point of oil changes in the engines of various units. It is expected that after these tests, in collaboration with the oil supplier and equipment manufacturers, the cost of oil changes can be improved.

În January the maintenance department moved into a new 7450 sq ft concrete-steel building illuminated with mercury vapor color-corrected lamps. This shop building includes three 20 by 40 ft truck or vehicle repair bays and one 20 by 40 ft general maintenance work area. A machine shop, together with an office for the maintenance supervisors and clerical

functions, is also incorporated into this building. A 25 by 25 ft separate pressurized air filtered room is adjacent to the main bays in which rebuilding of electric motors, diesel engines, transmissions, differentials, etc. is done. A toolkeeper supervises the tool-room which is stocked with all the necessary hand tools. The building also has a warehouse space to allow for the inventory storage of repaired or spare parts that have been charged out from the main warehouse. The five main bays are serviced by a ten-ton crane mounting two 5-ton electric hoists. Services to this building include a compressed air system, a centralized lubricating system, an acetylene and oxygen manifold system, and a distribution system for welding current.

Three months experience using the facilities of this new maintenance building has proven; (1) that maintenance work is costing less, (2) that better preventative maintenance can be done, (3) that centralized repair is more satisfactory than field repair and (4) that a ten percent decrease in manpower has been achieved over the arrangement previously used. A work order system provides written assignments to the respective foremen and individual mechanics and allows the maintenance supervisor to schedule work according to the overall operational priority. This same system provides for the direct tabulation of the manhours, material costs, overhead and general depreciation. Cost statistics developed from this system are advantageous to the operational department heads since it details the maintenance cost. This information is also valuable in preparing operating budgets.

CRYDERMAN SHAFT MUCKER

(Continued from page 43)

type rock bolts. Added support was provided by a ring of nine rock bolts between each set of timber.

All timber used was pressure treated with 0.75 lb per cu ft of chromated zinc chloride.

Air Scrubber Used

Twenty in. diameter galvanized air ducts lead down the shaft from a 15-hp blower on the 3070 station. The fan was set normal to blow down the shaft. After a blast the air flow was changed to exhaust the gas and smoke from the bottom. This gas and smokeladen air from the shaft bottom was discharged into a scrubber containing water sprays and a filter. Very little gas or smoke could be detected in the air emerging from the scrubber. In addition to the air scrubber, a water curtain from four spray nozzles was turned on in the ventilation drift be-

fore each blast. With this ventilating system, blasting in the shaft would be done at any time during the shift without interfering with the ventilation of the rest of the mine. All gas and smoke was cleared from the shaft bottom in 25 minutes.

No Serious Water Problems

No serious water problems were encountered. Water was pumped from the bottom to a 200-gal skid mounted tank, on the bottom of which was mounted a 30-NP motorpump which pumped the water to the 3070 level. The maximum amount of water pumped in the shaft was 60 gpm.

Performance

The table on page 49 is a comparison between mechanical and hand mucking in the Page shaft, but does not take into account the fact that the section sunk with the mechanical mucker had a cross section 12 percent

larger than the hand mucked section, and no rock bolting was done in the upper section.

An apparent saving of 7.41 man hours per ft of shaft was made by using the mechanical mucker. The over-all saving was reduced to 4.92 man hours per ft of shaft, chiefly by the extra time used to rock bolt.

	Mechanical Mucking	
Average advance per day (Two		
shift basis) Average advance	3.38 ft	2.68 ft
per manshift .		0.34

It must be again emphasized that sinking work was closely geared to our production schedule and over-all hoisting capacity at the Page shaft.



The largest crowd ever to attend an Annual Coal Division Conference was on hand to discuss technical problems of interest to the coal mining industry

ANNUAL COAL DIVISION CONFERENCE

Committees report on studies made during past year to large group of mine operators and equipment manufacturers. Honor paid to Glenn Southward

THE Annual Conference of the Coal Division of the American Mining Congress was held at the Penn-Sheraton Hotel in Pittsburgh on November 15. Over 450 representatives of coal producing companies and mining equipment manufacturers were in attendance to discuss technical problems currently occupying the attention of the coal mining industry.

Highlight of the conference was a luncheon meeting presided over by L. C. Campbell, chairman of the AMC Coal Division. Featured was an address by the Honorable Robert C. Byrd, Congressman from West Virginia, on "Cooperation Between Congress and the Coal Industry." Unfortunately, the illness of Mr. Byrd's father prevented his attendance, and his address was read by Mr. Campbell.

Byrd pointed out in his speech that national security would be impaired if there were any neglect of any part of the mobilization base. He said that the coal industry has suffered economically because of "short sighted" Government policies and declared that restriction of residual oil imports, an increase in the depletion allowance rate for coal, and establishment of a coal research development division are among Federal policies needed to place coal in a strong position in the defense structure.

He also expressed strong opposition to the participation of the United States in the Organization for Trade Cooperation. He declared that U. S. membership in OTC would "literally place the domestic economy at the mercy of an assembly of diplomats where a lone American voice would be lost in a chorus of foreign dialects."

A memorable part of the luncheon was the presentation by J. D. A. Morrow of a farewell tribute to Glenn B. Southward, mechanization engineer of the American Mining Congress, who retired December 31. The manufacturers of mining equipment, who have long been intimately associated with the work of the Coal Division, gave Glenn a high fidelity record player in recognition of his more than 30 years of service to the mining industry. Following the presentation ceremonies, the entire audience gave a standing ovation to this engineer who has done so much to advance coal mine mechanization.

Glenn joined the Mining Congress in late 1926 to investigate the progress being made by the industry in the development of mechanical coal loading. During the course of his original survey he visited every one of the coal mines east of the Mississippi River at which experiments with mechanized loading were going on. His mechanization surveys represented one of the first efforts in the industry to assemble and correlate infor-



Long to be remembered was the presentation of a farewell tribute to Glenn B. Southward, retiring mechanization engineer. Shown (left to right) are: the Honorable Cleveland M. Bailey, Congressman from West Virginia; J. D. A. Morrow, who made the presentation; the Honorable Elmer J. Holland, Congressman from Pennsylvania; Mr. Southward, and L. C. Campbell, chairman of the Coal Division

mation on mechanical coal loading. Much of the progress that was made in the early days of mechanical mining can be attributed to his efforts.

As the impact on mechanization on the coal industry increased, Glenn broadened his activities to take in coal preparation, ventilation, underground power, roof control, haulage and all other phases of modern coal mining. He was the guiding light behind the organization of the Coal Division of the American Mining Congress in the middle 1930's, and has headed up that work since. In addition, he has been responsible for the organization of the technical sessions of the Mining Congress' Coal Conventions-so important to the industry. One of the pioneers in mechanical mining, Glenn Southward has left an indelible mark on the mining industry in general and the coal mining industry in particular.

During the morning and afternoon sessions of the conference, 21 subcommittees of six Coal Division committees gave reports on a wide variety of topics. The rail haulage, conveyor and mechanical mining committees all reported during the morning, while the committees on coal preparation, underground power and roof support told of their work during the afternoon

The work of the Coal Division is planned with the original object of the Division in mind—to present the facts concerning modern mining methods and equipment to the industry, without recommendations or bias. Coal Division committees met at least twice a year, with further subcommittee meetings as necessary, to assemble and review information that is constantly being gathered by letter and personal contacts. As studies are com-

pleted, they are made available to the industry through publication in MINING CONGRESS JOURNAL. The only requirement for participation in the Coal Division's work is an interest in coal mining.

Following is an account of the reports as they were presented at Pittsburgh:

COMMITTEE ON RAIL HAULAGE

JAMES D. REILLY, Chairman

THE first report of the day was given by C. S. Szekely, chairman of the subcommittee on "Installation of Underground Rail Haulage." This group has studied data from 55 bituminous coal mines which show present trends in haulage road construction, including length of main line, weight of rail, type of rolling stock, seam height, grades and tonnages. The group reported that larger mine locomotives are being used, and, in combination with larger mine cars, larger trips are being hauled. Greater maximum grades are being used and main line underground haulage lengths have increased. Rail weights are greater, with 80 and 100-lb rail in common use in main line installations. The report was concluded with the statement that thinner seams are being mined economically with rail haulage and companies are constantly striving to modernize track installations and equipment.

The subcommittee studying the "Operation of Underground Rail Haulage," R. D. Flowers, chairman, gave the next presentation. Steve Krickovic made the report in the ab-

sence of Mr. Flowers. Included in the report were five case histories showing different practices in operating underground rail haulage systems.

Evan Adams completed the report of the haulage committee with a presentation of his subcommittee's study on "Maintenance of Mine Locomotives." Pointing out that the recommendations of the locomotive manufacturers should be followed in setting up any locomotive maintenance schedule, Mr. Adams said that any alteration in the maintenance schedule to take into account special conditions should be made in the light of the manufacturer's original specifications. He then described the maintenance program for each of three classes of mine locomotives, covering inspections and preventive maintenance overhauls and the operation of an efficient supply room.

COMMITTEE ON CONVEYOR HAULAGE

H. A. JONES, Chairman

THE conveyor haulage committee studies during the past year were concentrated on three general subjects. The first topic that was considered at the conference was the "Design of Underground Conveyor Systems." H. W. Meador, subcommittee chairman, was not on hand to present the study and in his place J. L. Thornton read the report. A belt convevor has certain inherent characteristics which must be taken into account if an all-belt installation is to prove economical. Most of the physical conditions encountered in coal mining can be met successfully with belt conveyor transportation, but certain belt characteristics must be considered in designing a conveyor system and steps taken to meet and not oppose them. The purpose of this report is to consider these items briefly, pointing out the factors which must be observed, but not necessarily attempting to set forth details of how they must be met.

In the basic design of a belt or chain conveyor, attention must be given not only to the quantity of material to be handled in a given period of time, but also to the physical properties of the material. Material size may be a controlling factor in the determination of belt width, pan size, and maximum conveyor slope angle. Abrasive wear and damage due to impact play a large part in the determination of belt and chain life. The physical properties of coal and associated rock must, therefore, be considered when selecting belting or chain, and when specifying auxiliary equipment for loading and transfer points.

Regardless of whether a conveyor is used for gathering, intermediate or main line service, several items should be given consideration. These include: belt strength; needed safety devices; anticipated installation, moving, and maintenance time; adequate capacity for maximum projected tonnage; sufficient motor power for starting under most adverse conditions; ample drive pulley size; loading and transfer station design; belt speed; layer vs. full-belt loading, and problems arising on long sub-mains and mains.

R. U. Jackson, chairman of the subcommittee on "Operating Methods for Underground Belt Conveyors," presented the next report. He pointed out that an underground belt conveyor system is a complex thing and that there is great need for protective devices to assure safety to the men and to prevent damage to the conveyor. Even with all of these facilities, the belt operation is not automatic; there must be a crew of trained men to see that the facilities are used in the proper manner, properly maintained, and that correct operating procedures are followed. He then listed several practices that have been found effective in obtaining high protection at low cost for underground belt conveyor systems. These include the effective use of slippage controls, emergency stop controls, sequence start and stop controls, test run provisions, protection against material pile-up, protection against roof falls, and protection against accidental reversal or overspeed. After summarizing an earlier committee report on the handling of man-trips and supplies by conveyor, Jackson concluded with the presentation of a chart showing the cause of major conveyor belt troubles and ways they can be corrected.

The third area of emphasis of the Conveyor Committee during the year was on "Maintenance for Under-ground Belt Conveyors." A. E. Long, chairman of this subcommittee, was not present and A. F. Burns presented the report. In an underground belt conveyor installation, maintenance is probably the greatest factor in promoting operating efficiency and reducing transportation costs. purpose of this study and report is to present practices in maintaining underground belt conveyors that have been found effective in reducing delays during the working shift and in increasing belt life. Of special importance is the need for periodic and frequent inspection of the conveyor with any needed repairs being made immediately rather than waiting until a major failure takes place. The committee recommends that all users of belt conveyors procure the excellent booklets on installation and maintenance of belt conveyors which are offered by belting and belt conveyor manufacturers.

Operating standards vary from mine to mine, but there are a few fundamentals under the general head of "good housekeeping" which should be followed in any conveyor installation. These are, cleanliness, proper drainage, timbering, and dust control.

When storing conveyor belting, the belting should be kept in a cool, dark, dry place, in areas where oils, gasoline or paint materials are not also stored. The belt storage area should not be near places where ozone is generated, and if belting is to be stored for long periods of time, it should be wrapped in waterproof paper. Moisture should be kept away from the belt. For short storage periods, a roll of belting can be set on a smooth, level, dry floor. For longer periods, the roll should be suspended on a level bar through its center. A roll of belting should never be stored on its edge unless it is protected adequately against moisture and slumping.

To obtain maximum life from underground belting, damaged areas should be repaired promptly. During retreat of a section or whenever a conveyor is shortened, the belting removed from service should be carefully inspected and repaired if necessary. Where it is impractical to provide complete repair facilities at the mine, belting may be sent to private firms that specialize in this service.

The report was concluded with a chart showing items that cause belt wear and how these can be cured.

COMMITTEE ON MECHANICAL MINING

WILLIAM E. HESS, Chairman

FIRST report of this committee was the report of the subcommittee on "Industrial Engineering," by E. B. Leisenring, Jr., chairman. The final report of this subcommittee was presented in full in the November, 1957 issue of MINING CONGRESS JOURNAL, and G. W. Lockin, who presented the report in Mr. Leisenring's absence, discussed the highlights.

The report of the subcommittee on "Dust Control for Continuous Mining," J. A. Younkins, chairman, was given next. Following the publication in the May issue of MINING CON-GRESS JOURNAL of its survey on water spraying as a means of dust control in continuous mining operations, the subcommittee has begun studies of auxiliary fan installations for ventilation and dust control in continuous mining operations. The description of two auxiliary fan installations have been obtained to date. At Mine A, where an exhaust fan is being used with a ripper type miner, the auxiliary fan provides adequate ventilation at the working place. The fan is placed in the last crosscut and a two-ft diameter tubing is extended from it to approximately 15 ft from the face.

A check made from plastic or double layers of jute brattice cloth is built around the fan so that the motor drive is on the intake side of the check. The fan discharges on the return side. A by-pass for the air in the ventilating circuit in excess in amount of that the fan takes is constructed by leaving an opening in the check at the fan. Dust formed during mining and the fog from the water sprays is quickly drawn into the tubing, leaving the atmosphere in the working face relatively clear and comfortable. Measurements taken with a "Velo-meter" show that the fan will pull from 5000 to 7000 cfm through 280 ft of tubing. Water gauge varies from 3 to 41/2 in. This amount of air has been adequate for good ventilation of the working place. Measurements taken for comparison, show a maximum of 2000 cfm at the working face when using 140 ft of well-construction line brattice.

The second installation is in Illinois where a blowing fan is used. The fan, driven by a five-hp motor operates at 1750 rpm to develop seven in. of water gauge and deliver 3650 cfm through 110 ft of 12-in. tubing. Face ventilation is good, the air velocity near the face ranging from 120 to more than 200 fpm. Smoke test shows a definite sweep across the front of the boring type miner, clearing both corners of the roof, face and rib. Air currents at the face were also influenced by the rotating arms of the unit and by the cooling fans installed to ventilate the drive motors. These create an air turbulence that assists air movement to the difficult-to-ventilate areas front of and under the head of the unit.

Visibility at the face is adequate; it is possible in most cases to observe the cutting arms operating from the outby end of the unit. Water sprays are used to reduce the amount of coal dust going into suspension.

Final report of the morning was presented by F. R. Zachar, chairman of the subcommittee on "Continuous Mining Systems." This study is planned to present to the industry a report of mining systems employed in operating continuous mining machines, giving as many details as possible on why the system employed was selected. Mr. Zachar's report covered four continuous mining operations. Data was collected at these operations on the type of roof and bottom, seam height, cover, ventilation requirements, transportation facilities, type of equipment used, and other factors influencing the selection of the mining system.

COMMITTEE ON COAL PREPARATION

R. L. LLEWELLYN, Chairman

THE first Coal Division committee to report during the afternoon session was the Committee on Coal Preparation. Jack M. Bishop, chairman of the subcommittee on "Maintenance of Thermal Drying Equipment," presented his group's final report. Operating data on 41 heat drying units in coal fields the country over were correlated in this study to show the mining industry's current practices in the operation and maintenance of thermal dryers. While no sweeping conclusions were reached, upon analyzing the material collected, all who were connected with the study were sure of one thing-thermal drying is here to stay. Perhaps just as significant as the information on existing thermal drying installations that was collected was the interest shown by companies not now using heat drying equipment. To those who are planning to make thermal drying installations in the future, and to all preparation men who are interested in seeing "how the other fellow does it," this report will prove of value. It shows what is being done with different types of drying units under a wide variety of conditions. The complete report was published in the September issue of MINING CONGRESS JOURNAL.

The subcommittee on "Washery Water Clarification," J. J. Reilly, chairman, was the next to report. Pointing out that with current developments in mechanical mining there is an increase in the amount of mines in the raw coal feed to the preparation plant, and in the impurities in the fines, the subcommittee has reached the general agreement that there are two phases which are closely related to the water clarification problem-solids control and maximum economic recovery. It has been established that degradation in the plant, due to recirculating solids in the circulating water system, adversely affects plant results. The subcommittee showed by case history that with clean water a preparation plant can process more tonnage, produce a better and more uniform product, and reduce plant maintenance.

In dealing with solids control, a plant operator must establish the plant build-up size and the necessary plant bleed. Fines that come into the plant must then be removed along with fines made within the system. After the amount of fines that must be removed in order to balance the system is determined, the means of disposal must then be established. In some cases enough plant bleed, containing the solids build-up, can be pumped to a pond to balance the circuit. In other systems the fine material can be fluocculated and removed with filters. Once the circulating solids are under control, it is wise to analyze the material that is being wasted and get into the second phase-that of maximum economic recovery of fuel values. Reilly concluded the report of the subcommittee by presenting reports of two coal companies that are cleaning up their circulating water and thereby reducing the buildup of fines in the system.

The final report of the Committee on Coal Preparation had to do with "Coal Analysis Procedures." Jack "Coal Analysis Procedures." Bishop presented this report. Realizing that ASTM standards for ascertaining the moisture, ash and sulphur contents of a coal sample were entirely too long for practical application at many coal preparation plants, this subcommittee has undertaken the job of determining shorter standard procedures that will be acceptable to ASTM and the coal industry. Although this group has been organized but a short time, much work has already been performed in the establishment of data to back up various testing procedures.

COMMITTEE ON ROOF ACTION

J. ALLAN BROOKES, Chairman

THE first group of the Roof Action Committee to report was the sub-committee on "Design of Mine Roof Bolting Systems," E. H. Johnson and L. A. Panek, co-chairmen. This report, published in the August issue of MINING CONGRESS JOURNAL is based upon the work done by L. A. Panek and published by the U.S. Bureau of Mines in three Reports of Investigations, No. 5154, No. 5155 and No. 5156; "Theory of Model Testing as Applied to Roof Bolting," "Design of Bolting Systems to Reinforce Bedded Mine Roof" and "Principles of Reinforcing Bedded Mine Roofs With Bolts." These reports comprise a truly scientific approach to These reports comthe problem of reinforcing roofs with bolts. Heart of the subcommittee's report is a Roof Bolting Design Chart which enables one to determine the relative amount by which the roof is reinforced with different bolting pat-

"Improved Types of Bolting Equipment," was the title of the next subcommittee's report. V. A. Curry, subcommittee chairman, made the presentation. This subcommittee been studying ways and means to improve present types of bolting equipment and during the past year concentrated on devices which would permit the making of visual determinations of existing bolt tensions. Two

types of visual indicators have been given study. One type consists of specially forged self-centered head bolts, specially embossed plates and concave steel spring washers. The washers are so designed to indicate variations in loading and unloading. The other type of visual indicator consists of two circular steel plates between which a layer of rubber has been bonded. When tension is applied to the bolt, translated into compression between the two plates, the rubber between the two plates expands or contracts as the load varies. By using a special gauge, the tension on the bolt is indicated on the gauge.

One of the members of the subcommittee designed a new type roof bolt head having a specially forged flash which will flatten out under pressure. The purpose of this design is to indicate whether or not a selected tension was applied to the bolt when it was installed. It will not indicate whether or not the bolt is unloaded after it was installed.

The subcommittee also reached the conclusion that a large part of the success or failure of any bolting program lies in the performance of the bolting crew. Rules for roof bolting were drawn up, emphasizing the need to maintain uniform bolt hole sizes. This can be done by strict supervision underground, proper reconditioning of bits, training, and just plain hard work.

Two reports were presented by the subcommittee on "Geological Aspects of Mine Roof Control," G. R. Spindler and C. T. Holland, co-chairmen. One of the subcommittee's reports was entitled "Geological Aspects of Mine Roof Action and Control" and showed the supporting strength of roof bolt anchorage as related to installation torque and the characteristics of the anchorage strata. Published in July in MINING CONGRESS JOURNAL, the report was designed to correlate field data with respect to the rigidity and supporting strength of roof-bolt anchorages and materials of varying degrees of hardness and stability with variations in the torque applied to the bolts in their original installation. Field data was collected principally from the Pittsburgh coal seam in northern West Virginia under conditions which permit bolt anchorage in the firm "black rock" in some areas but requires anchorage in rather soft shields in other areas.

A short report on the recent accomplishments in the relationship between mine roof action and mineral content was presented by C. T. Holland. Actual mineral analysis of coal mine roof and floor samples has been continuing since the publication of the report "Mineral Content-A Factor in Weathering of Mine Roof," by C. T. Holland. Because insufficient information has geen gathered, no definite conclusions can be drawn from material presented, however, the following tentative observations can be made:

1. Most of the roof and floor rocks which mining engineers have been calling shales, fire clays, clod, etc., are in reality silt stones or fine grained sandstones. Some standards should be evolved on this phase of the problem so that geologists and mining engineers mean the same things by the same terms. At present this is probably not so.

2. Clay has a pronounced effect upon the strength of a rock when wet. High clay content seems to indicate a weak rock when wet, mine roof and floor rocks in the mine are usually water-saturated.

3. Floor rock containing up to 32 percent clay have made satisfactory mine floors insofar as pillar load support is concerned. This is not necessarily true insofar as forming satisfactory roads for shuttle car haulage. It is suggested that the relationship between the composition (mineral) of floor shales and their suitability for haulage be investigated. For example, the likelihood that a floor will go to mud when used as a road for shuttle cars is probably related to its (the floor) mineral composition. Remedial measures may be available. At least, foreknowledge of the condition might be obtained and suitable provisions be made to alleviate this condition when planning the mine.

COMMITTEE ON UNDERGROUND POWER

JOHN A. DUNN, Chairman

THE final committee to make its report at the annual Coal Division Conference was the Committee on Underground Power. First subcommittee to report was the one on "Field Splices in Mine Trailing Cables," R. G. Sturdevant, chairman. The purpose of this study is to prepare and to present to the mining industry recommendations for improving the methods now in general use in making temporary or field splices in trailing cables underground. It was recognized that this would involve an evaluation of the performance characteristics of the splices as they are now made and a study of improved procedures and materials for making such splices. Such a program would require extensive test work and it was suggested that the cooperation of cable manufacturers be solicited in carrying out this work. At the meeting on July 17, 1956, of the subcommittee, the following program was developed:

Obtain samples of temporary splices made in accordance with pres-

ent practices and using present materials and evaluate them as follows:
a. Determine the breaking strength, electrical resistance under a 12-lb. tension and resistance to repeated splicing of the conductor splices. b. Determine the voltage breakdown, insulation resistance and resistance to moisture of the insulation and jacket splices.

In its first report, published in the October issue of MINING CONGRESS JOURNAL, data was presented showing the comparison of temporary cable splices with unspliced conductors. The tests were made on Size 4, Awg 133 Strand, Type W or G parallel cables.

With the first step of the subcommittee's program completed by the publication of its report, the next step is to investigate possible changes in connectors with connector manufacturers for improving the performance of conductor splices under repeated flexing and to investigate improved insulation and jacket splicing compounds and methods of applying them in temporary splices. After this has been done, the subcommittee contemplates evaluating the improved temporary splices resulting from the studies made in improving connectors and splicing compounds and methods of applying them in temporary splices.

Next to report were the several task groups of the subcommittee on "A-C Power for Face Machines."
C. S. Conrad reported on "Engineering of A-C Underground Power Systems." He discussed substation considerations, bore hole suspensions, cables, voltage regulation, cable installation, and branch circuits in underground systems as they apply to high voltage systems; and in connection with low voltage systems discussed underground substation considerations and a-c power for illumination.

Frank Hugus presented a progress report of the task group studying "Characteristics of A-C Mining Machinery and Application of Motors and Control to A-C Mining Equipment." Since the eastern United States coal mining industry is quite familiar with d-c mining equipment, this group feels it logical to present information on a-c mining equipment by comparing a-c characteristics with those of d-c. Hugus discussed plans of the subcommittee, saying that a considerable amount of data had been collected but not yet correlated.

Although it was not presented formally, a report on "Proposed Standards for Transmission and Distribution of Alternating-Current Electric Power for Face Areas in Coal Mines," was distributed to the meeting. These proposed standards will be reviewed and discussed at future meetings.

W. P. Place, chairman of the subcommittee on "Frequency Coordination for Underground Communication" pointed out that this group was taking a long look to the future to determine just what need there is for the establishment of carrier current frequencies for communications, remote control circuits, television, etc., in underground mines. At this time it appears that there would be great advantage to the establishment of frequency limits for certain types of duties.

The final report of the day was given by John Buss, chairman of the subcommittee studying "Permissibility Problems." In the two years since U. S. Bureau of Mines Schedule 2F was officially issued, there have been many discussions, pro and con, concerning its new and different fea-tures. This has led to more than casual consideration of the desirability of amendment of the schedule. The Committee on Underground Power is attempting to serve a useful service by developing a better understanding of permissibility problems through discussion and study. Schedule 2F represents a tremendous improvement over Schedule 2E to coal mine operators. It provides new opportunities, along with new responsibilities to the operator and makes possible the fullest contribution of the enormous reservoir of engineering know-how and ingenuity already available in the engineering and maintenance staffs of operating companies. To equipment manufacturers, however, it has generated mixed feelings. In full accord with any development in the advancement of safety, the manufacturer, at the same time, foresees future trouble, and possible lessening of standards of safety. An effort has been made to consolidate experiences of operators with those of manufacturers in a report which would serve as a basic recommendation for constructive improvements of Schedule 2F. To date, however, the experience of the operators has been so limited that no concrete opinions have been formed. The manufacturers, on the other hand, as a result of long experience in permissibility problems, have been quick to see a number of bad points in the new schedule. The items that are giving concern to equipment manufacturers are: The subject of public demonstration; the reference to "a qualified representative of the Bureau" as contained in Section 18.23 of the schedule; the assembly of certified components, and the present method of approval of field assemblies. The subcommittee report concluded with a statement that specific recommendations for constructive amendments of Schedule 2F will not be offered until coal mine operators have more experience under the schedule.

Preventing Stream Pollution

THIS report describes the methods being used in surface mining operations in Ohio to prevent the pollution of water. The conditions to be met and the practices used are, to some extent, uniform for Ohio coal strip mining operations, but it is not to be implied that they are considered applicable to all operations or that they are recommended for any particular operation elsewhere. Their need, and their adaptation to your conditions, are left entirely to your discretion.

As director of the Ohio Reclamation Association, the writer is concerned with those matters pertaining to land and water use which affect the indus-The association is a service organization of the surface mining industry, but it does not engage directly in research. It fosters research by agencies properly suited to that endeavor, interprets the results of that research in terms of the conditions to be met, and offers recommendations which make it possible for the operator, through proper engineering, to apply those research results to his particular conditions.

The acid mine water research at Mellon Institute is conducted by Dr. S. A. Braley. No attempt will be made to describe the results of Dr. Braley's research efforts, but some of the principles the Ohio Reclamation Association gleaned from that research should be pointed out, since they form the basis for the recommendations it makes to the operators.

Water Pollution Is Relative

Water pollution is not absolute. The writer has been asked by intelligent men when he thinks we will be able to clean up water pollution. There really is no such thing. Water as it reaches us is not just plain H₂O. Even rain water picks up many elements from the air before it reaches the earth, thus becoming polluted. The effect of this pollution depends upon the use to be made of the water. In other words, "One man's meat is another man's poison." Also, two pollutants may serve to nullify each other. On the other hand, two pol-

Here is what the surface mining industry in the state of Ohio is doing to prevent or reduce stream pollution

By LARRY COOK
Executive Vice-President
Ohio Reclamation Association

lutants, each harmless to a particular use, when mixed together may become harmful to that use. So it is that water pollution is relative rather than absolute. For this reason, and because it is relative under both the water rights laws and the water pollution laws in Ohio, the association recommends that all water in the area of the operation be tested before the operation begins. These tests need not be elaborate, but they should be recorded. Many of our operators also ask us to make regular, periodic water tests. It has often saved considerable trouble and expense.

Pollution of water in surface mining operations falls into three types: suspended solids, acids and discoloration. The first of these, suspended solids, is generally associated with the coal fines in the water that has passed through the preparation plant. Equipment is available for mechanically recovering a major part of these fines, but in order to remove them to the point where the water may be used again or released without danger of pollution, it is generally considered necessary to make use of settling basins. Of the 24 coal preparation plants in Ohio, one is using a municipal sewer system for the disposal of excess water, three are directing the effluent into abandoned mines, and 20 are using settling basins. Twentythree of the 24 plants are operating to the satisfaction of the Ohio Water Pollution Control Board, and the remaining plant is under a temporary permit while it completes expansion of its basin facilities. A third of these plants are operating on a closed system.

Settling basins of varying kinds are also used in many of our operations for the removal of silt, the impoundment of acid water and, in at least one instance, the removal of discoloration as well. This particular case came to our attention during a period of extreme drought when numerous complaints were made that the stream below the operation was running red with acid coming from this mine. Every dead fish that could be found was produced in evidence, and swimmers complained of smarting eyes, breaking-out on the skin, and other various ill-effects. Tests revealed that the water coming from the operation was acid, but that this acid was aluminum sulphate produced by the sandstone overburden, which did not account for the red color. From other sources in the operation iron carbonate was found which, although it produces red discoloration, is definitely not acid. It was decided to build a sump and settling basins. All the water from the operation was then directed into the sump, where it is mixed with lime sludge before being pumped to the basins. Here the lime serves to flocculate the iron out of the water, although it has little effect upon the pH. The latter problem was solved by siphoning off the water in the basins at periods of high flow in the stream. Thus both discoloration and acid were eliminated as problems Settling ponds solve the problem of suspended solids and, in this case, that of discoloration as well. Water from the operation is collected in the sump on the right, mixed with lime sludge, then pumped to the settling basins. It is clear when it enters the streams





Acid-bearing overburden produces acid water within a short time after exposure to the air. In this Ohio strip mining operation, the acid water has been impounded in the final cut of the operation where it can do no harm. This water, the run-off from the toxic overburden, is slate blue and extremely toxic

The same area as in the previous picture is shown as it looked at a few years later. The worst of the acid has leached out of the overburden and growth has started. Calcareous materials in the overburden have also served to bring up the pH of the impounded water to the point where it will now support aquatic





View shows a tinal cut lake in a strip mining operation where the overburden is not acid bearing. The water has been impouned to cover the exposed coal seam and prevent the formation of acid in the material adjacent to the seam by stopping oxidation. Fortunately, only about five percent of Ohio stripping produces a toxic overburden

Acid Pollution Problem

Acid is unquestionably the major water pollution problem of the mining industry. It is formed by moisture and air coming in contact with acid bearing materials. The action begins immediately with the exposure of the material-the rapidity of the action depending upon the type of the material. So far the laboratory has not found a suitable substance to prevent this action or to neutralize it on a large scale under the conditions mines have to meet. By applying certain principles experimentally in the field, means of combatting the situation are being found. These efforts are directed at prevention rather than cure. They are, however, primarily applicable to surface mining operations, where a greater freedom of action enables us to make use of them under widely varying conditions.

In active operations the aim is to segregate the acid bearing material, covering it where possible to prevent it from oxidizing. This is generally accomplished by a judicious handling of the spoil and by keeping the operation clean. Often the toxic material is found just above the coal seam. Where practical, this is not handled with the overburden but is dozed to the base of the spoil and buried in the succeeding cut. In some cases, almost the entire overburden is composed of an acid sandstone. Segregation of the material in such cases is not feasible. Then, attention must be turned to the possibility of segregating the water so that it does not become a carrier of the acid. No operator, of course, wants water in his operation, and to bring up the subject of properly handling it in the spring, when his equipment is mired in a solution too thick to pump and too thin to shovel, is to invite disaster. Sometimes, however, it is possible to segregate the water from the acid bearing material if the acid problem is understood by the operator.

Gob is a source of acid which is being given more attention by our operators. Generally they are discontinuing the practice of using it to build dams and roads. It is not good road material, it is unsightly long after the operation has ceased, and it produces acid. What to do with gob is another problem, but one which is often easily solved if properly planned. Some operators are trucking it back into the spoils and burying it; others are placing it in a depression where it can be flooded. One of our operators is crushing it and piping it to a pond where it is immersed in water.

A Positive Method

That brings up the most positive means of inhibiting the formation of acid yet discovered. This is the method of preventing the air from getting to it by covering it with water. It is a positive method as contrasted with that of covering it with earth, where some oxidation can still take place, and water filtering through it pick up the acid and carry it out. Strip mine operators have been making use of final cut lakes to prevent

the formation of acid for many years. Even in our part of the country, where the operations are on the contour and it is necessary to dam the cut to impound water, it was long ago discovered that the formation of acid in the refuse and bone coal at the bottom of the pit could be prevented by such a method. Today, over potentially toxic material, lakes teem with So successful has this method been that Ohio law now requires that upon completion or abandonment of a strip mining operation, where it is feasible, and where to do so "will not seriously interfere with existing mining operations, nor preclude the practical operation of the business of mining in the future," that the "loose coal, mine refuse and other debris on the bottom of the last cut of an operation" be graded "to reduce the piles of such material for the purpose of promoting their possible submergence by water," and that earth dams be constructed in the last cut "to aid in creating lakes and ponds for the purpose of increasing the supply of available water, flood control, erosion control, or water pollution control.'

It is not considered feasible to water on the edge of steep slopes if conditions are such that it might cause slides. In such case the pit is left open, and the loose material on the bottom of the cut graded to prevent water from standing to form acid pools which could be flushed out by rainfall. This section of the Ohio law was based upon recommendations by Dr. Braley, and was written with the approval of our operators.

Operators are fortunate in Ohio in that only about five percent of their stripping produces toxic overburden. In these instances, since they are required by the reclamation law to grade, the association recommends that the grading be done so that the water from the surface of these areas is drained into the pit and impounded. This water is usually toxic but the acid gradually leaches out of the material, and over a period of time other elements generally serve to neutralize the water. Ohio has such areas which a few years ago were toxic, but which today are covered with vegetation, and the water in the impoundments are supporting fish. Credit for some of these methods must go to Dr. Charles Riley, professor of Wildlife at Kent State University, who serves as a consultant to the Ohio Reclamation Association.

In closing, water pollution is relative. In some cases severe pollution may cause no damage, and in others a slight pollution may be harmful to other uses. In Ohio the industry is trying to prevent it where possible, or reduce it to the extent possible. Operators must live with their neighbors, and they want their neighbors to be able to live with them.

Behavior of Metals Other Than Uranium In Liquid-Liquid Extraction Processes

By C. J. LEWIS and E. H. CRABTREE

Respectively,
Manager, Chemical Division, and
Director, Colorado School of Mines
Research Foundation, Inc.

THIS presentation originates from work sponsored by the Colorado School of Mines Research Foundation. The program has as its long range objective (1) the discovery of fundamental scientific principles pertaining to the liquid-liquid extraction of metals, and (2) the dissemination of this information on a gratis basis to all who may be interested. Purpose of this article is to present data on the behavior of metals other than uranium in the liquid-liquid extraction process.

The liquid-liquid extraction operation involves two immiscible phases, the one organic and the other aqueous. Metal in the aqueous phase is concentrated by extraction into a relatively smaller volume of organic phase. By a reversal of the extraction operation, the metal is then yet further concentrated into an even smaller volume of aqueous product.

Choice of Extractant

In previous presentations, the authors have called attention to similarity between some mechanisms of the ion exchange resin process and those believed to govern the liquid-liquid recovery of uranium. The extractants now used are either cation exchangers or anion exchangers. The cation exchangers, which extract positively charged ions are represented by a group of kerosene soluble-water immiscible organo-phosphates. Among these is di-2-ethyl-hexyl-phosphoric acid, commonly referred to as DEHPA. The anion extractors exchange negatively charged complexes or ions, and presently constitute a group of kerosene soluble-water immiscible amine salts. Among these is Rohm & Haas' Amine 9D-178.

Since uranium in its sulphuric acid leach solutions exists in an equilibrium involving uranium in both anions and cations, uranium can be extracted into the organic phase by either anion exchangers or cation exchangers. Likewise, when metals other than uranium exhibit a similar anion-cation equilibrium, they should respond to either type of extractant. This situation is illustrated with respect to molybdenum in Figure 1.

However, most other metals do not simultaneously exhibit both anion and cation characteristics in their acid solution as do uranium and molybdenum. For this reason, when studying the behavior of metals other than uranium in liquid-liquid extraction systems, it is not often that a choice between organo-phosphate of amine is offered. Instead, the use of organophosphate or amine is dictated by the one ion form in which the metal This article deals primarily with the organo-phosphate extractant and the chemical principles underlying its application to positively charged metal ions.

The pH Value—a Dominant Factor

If the behavior of metal cations during liquid-liquid extraction is principally controlled by ion exchanging mechanisms, it should follow that hydrogen ion concentration, or, as this is more commonly called, pH value, is a dominant factor. This is illustrated schematically in Figure 2. We have assumed there is a primary equilibrium between the exchangeable hydrogen of the organic phase and the hydrogen associated with the acidity of the aqueous phase. The metal cation under investigation then becomes a pawn in an equilibrium cycle. This environment suggests that (1) neutralizing the acidity (increasing the pH) of the aqueous phase will permit more hydrogen ions from the organic phase to move into the aqueous, thereby causing more metal ion in the aqueous to move into the organic; and (2) increasing the quantity of aqueous phase hydrogen ion relative to the organic will force hydrogen ion into the organic, thus causing the metal ion already in the organic to be returned to the aqueous; and also that (3) this same effect may be realized by increasing the acidity of the aqueous phase (lowering its pH). This latter is essentially what occurs during the stripping operation of the liquid-liquid extraction process.

FIGURE 1

V. Cal	· L Extraction	1000	
(A) Aqueous Phase (O) Organic Phase	App. 1 gm. per 1 5 wt. pct. organi harasane		
Phuse Mixing Time	2 mins.	A.0	4/1

pH edjustments with NeOH
pH equeous phase at start of extraction 1.0

PERCENT METAL EXTRACTED

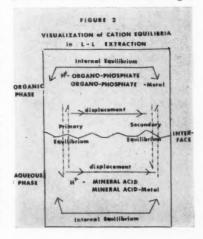
Metal	Secondary Amine*	No. 5 44	Organo-Phos DEHP A ##1
Uranium Pr Solution	*8- 80-0	86.0	98.3
Molybdenum Set'n.(exidis	Pres 92.8	78.4	54.6
Molybdenum Sol'n.(reduc	84.3	96.4	79.8

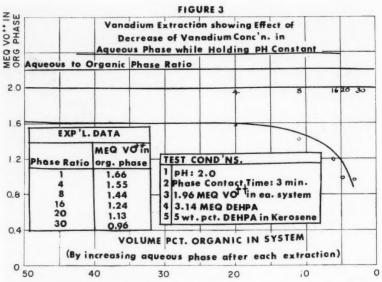
* R& H

***Carbide & Carbon Chemical

Figure 3 presents data illustrating how variation in the relative volumes of the organic and aqueous phases affects the distribution of a fixed quantity of metal ion in the system, even though aqueous phase pH remains constant. It may be noted that the mass effect of hydrogen ion in the increasing volume of aqueous phase has stripped vanadium from the organic phase. Figure 4 on the other hand illustrates the effect of aqueous phase acidity. In obtaining this data an aqueous solution of vanadium sulphate was contacted with DEHPA in kerosene with the aqueous phase having its pH adjusted by additions of caustic or sulphuric acid as required. These adjustments were made directly in the separatory funnel with both phases in contact at all times. It may be noted that by such adjustment the system was taken from loading through stripping and back to loading without removing the system from its container.

When separate sulphuric acid solutions of metals are extracted with organo-phosphates, data as reflected in Figure 5 may be obtained. The experiments yielding this data made use of a uniform concentration of one gram per liter of metal in the aqueous phase, a concentration of five weight





percent organo-phosphate in kerosene and an aqueous to organic phase ratio of four to one. This data reflects the percent metal extracted from the aqueous phase as a function of aqueous phase pH at the beginning of extraction. While such data may have practical significance, it affords small clue to the underlying principles controlling extraction of these metals.

Subject of Law of Chemical Equivalency

However, continuing on the premise that ion exchange principles control the behavior of metals in this process, it should follow that the exchange of ions between the organic and aqueous phase is subject to the law of chemical equivalency. Stated in another way, one atomic weight of exchangeable cation in the organic phase should permit the loading of not more than an equivalent weight of metal cation into the organic phase. state this in still another way, the ability of the organic phase to extract, may be limited by the equilibria already noted, but if such equilibria is conducive to maximum extraction, such extraction will approach but cannot exceed the ratio of ion equivalency. From the structural formula and molecular weight of the organophosphates, their equivalent weights can be calculated. It should follow, therefore, that if the species of cation is known, its maximum loading into a unit quantity of organo-phosphate can be calculated in advance, or if the ion species is not known, it may be established by determining its maximum loading into a known equivalency of organic extractant.

From the meager amount of data we have obtained on this point, these considerations thus far appear to be valid. In a typical experiment, sulphuric acid solutions of copper, vanadium and uranium were extracted, assuming the ion species to be as indicated in Figure 6. Extraction conditions were adjusted stepwise to approach those favoring maximum loading into the organic phase. It can be observed from the data summarized in Figure 6 that as maximum organic loading was approached, the ratio between the equivalent of organic reagent present and the equivalent of the ion extracted approached unity.

On the other hand, behavior of ferric ion in a similar experiment indicates the complications which may arise as the result of the ion species. If it is assumed that ferric iron undergoes species metamorphosis in passing from ferric ion to ferric hydroxide precipitate, the amount of iron ion species which can be extracted can be calculated. The calculations indi-

cate that an organo-phosphate such as DEHPA can be substantially overloaded with iron, calculated as the ferric ion, while nevertheless conforming to principle of chemical equivalency. Confirmatory data illustrating this effect of iron ion species on organic loading is summarized in Table 7. It is probable that other metals will behave similarly in liquid-liquid extraction processes.

Basicity of Metal Important

Further examination of some of the data already presented suggests that the basicity of the metal ion is closely associated with the effect of aqueous pH on the extraction of the metal by organo-phosphates. For example, the weakly basic uranium ion may be efficiently extracted from an aqueous solution at pH 1.0, more strongly basic ferric iron responds best at an aqueous pH of about 2.5, whereas much more strongly basic aluminum requires an aqueous pH of around 4.0 for good extractability by the organophosphates used. The importance of this consideration is illustrated by data obtained during the extraction of a mixed sulphuric acid solution of uranium, vanadium, ferric iron, alu-minum and copper. The metal ions were present in the aqueous phase in concentration proportional to their equivalent weights and assumed ion species. This aqueous head was stage contacted with sufficient organic phase to theoretically extract just one equivalent of metal per contact. The loaded organic phases were then converted to residues by evaporation, and analyzed by semi-quantitative spectrographic analysis. The data thus obtained is shown in Table 8. The possibility of using this principle for selective extraction of metals is obvious.

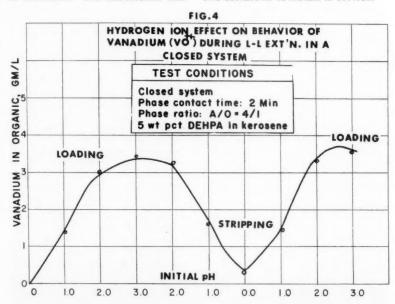


FIG. 5 PERCENT METAL ION EXTRACTED DURING SINGLE-STAGE L-L EXTRACTION USING ORGANO-PHOSPHATE REAGENTS

(A) Aqueous Phase: Approx. I gram/liter metal ion in H₂SO₄
(O) Organic Phase: 5 weight percent reagent in kerosene
A/O • 4/1 Phase Mixing Time: 2 Min. pH adjusted with NaOH

Metal	ALUMINUM'S	COBALT 12	CHROMIUM-6	CHROMIUM'S
pH	1.0 3.0 5.0	1.0 3.0 5.0	1.0 3.0 5.0	1.0 3.0 5.0
% Ext. DEHPA	4.6,15.095.8	0.0 2.9 8.8	0.0 0.0 0.0	0.0 1.6 14.3
%Ext. No. 5	22.347.1 95.8	1.123.724.4	6.4	10.0322 46.6
Metal	COPPER*2	IRON+3	IRON*2	NICKEL+2
pH	1.0 3.0 5.0	1.0 2.5	1.0 3.0 5.0	1.0 3.0 5.0
%Ext. DEHPA	0.0 4.4 8.8	30.461.2	1.3 7.013.7	0.0 0.0 0.0
% Ext. No. 5	11.2 40.438.9	50.477.2	13.7 17,2 27.2	2.411.2 9.5
Metal	Mo*6	Mo+3	SELENIUM'4	THORIUM*4
pH	1.0 3.0 5.0	1.0 3.0 5.0	1.0 3.0 5.0	1.0 3.0 5.0
% Ext. DEHPA	54.6 38.4 3.4	79.829.9 6.3	0.0 0.0 0.0	93.510000000
% Ext. No. 5	78.4 47.8 16.6	96.491.2 93.2		97.8 91.9 71.2
Metal	TITANIUM-4	TITANIUM+3	YTTRIUM*3	ZINC*2
pH	1.0 3.0	1.0 3.0	1.0 3.0 5.0	1.0 3.0 5.0
% Ext. DEHPA	62.01000	67.198.3	30.155.047.9	0.0 42.946.2
% Ext. No. 5	00.000.00	94.500.0	36.3 43.0 36.6	6.5 36.3 37.4

FIG. 6 L-L EXTRACTION - CHEMICAL EQUIVALENCY

Organic Phase: 50 ml (5 wt pct DEHPA in kerosene) containing
6.27 mea exchangeable H ion (calculated)
Aqueous Phase: 200 ml containing 12.5 mea metal ion in H₂SO₄

Phose Ratio: 4 aqueous/lorganic

Extraction Time: Three 2-Min contacts pH adjusted with No

EXTRACTION	OF	COPE	PER	(Cu+	2)				
Initial pH	1	2	3	4	4.5	5	5.5	6	6.5
Theoretical Mea Exchangeable H* in organic before extraction	6.27	6.2?	6.27	6.27	6.27	6.27	6.27	6.27	6.27
Actual Meq Metal Ion found in organic after extraction	0.24	0.24	0.68	0.97	1.46	2.33	5.98	6.23	6.23
PERCENT EXTRACTION	3.8	3.8	10.9	15.5	23.3	37.2	95.4	99.4	99.4

EXTRACTION	OF	VAR	IADI	UM (V0+2)	
Initial pH	2	3	4	5	6	7	8
Theoretical Meg Exchangeable H*	6.27	6.27	6.27	6.27	627	6.27	6.27
Actual Meg Metal Ion	4.99	5.50	5.85	5.91	5.85	6.48	6.00
PERCENT EXTRACTION	79.6	87.7	93.3	943	93.3	1034	95.7

EXTRACTION	OF	URA	NIUN	(UO	(2)
Initial pH	0.5		1.5	2	2.5
Theoretical Meg Exchangeable H.t.	6.27	6.27	6.27	6.27	6.27
Actual Meg Metal Ion	5.58	6.29	6.33	6.36	6.27
PERCENT EXTRACTION	89.0	100.3	101.0	101.5	1000

FIG. 7 EFFECT OF ION SPECIES ON ORGANIC LOADING

Organic Phase: 50 ml (5 wt pct DEHPA in kerosene) containing 6.27 meq exchangeable H ion (calculated)

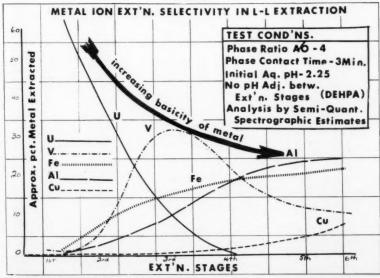
Aqueous Phase: 200 ml containing 12.5 meq metal ion in H₂SO₄

Phase Ratio: 4 aqueous/I organic

Extraction Time: Three 2-Min contacts pH adjusted with NaOH

	A		B						
lon Species	meg of exchangeable H ion	Meq of assumed ion species found in organic phase			Ratio B/A				
			pH I.5		pH 2.5	pH I.O	pH 1.5		
Fe***	6.27	5.88	6.60	8.39	9.81	0.94	1.05	1.34	1.5€
(FeOH)*	6.27	3.92	4.56	5.59	6.53	0.63	0.73	0.89	1.04
[Fe(OH),]	6.27	1.96	228	2.79	3.27	0.31	0.36	0.45	0.5

FIG. 8



Prospects for Future

In summary, therefore, it appears that:

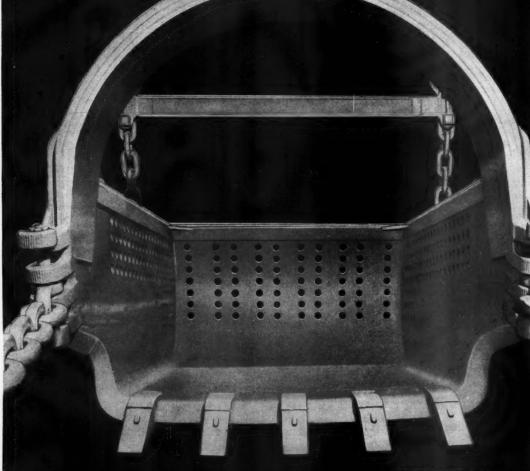
(1) Metals which like uranium exist in an acid solution containing both anion and cation forms of the metal may be recovered by either organo-phosphate or amine liquid-liquid extraction reagents.

(2) When the metal exists as only anion or cation, the choice of extractant is limited accordingly. (3) The ion exchanging mechanisms using organo-phosphates are in agreement with the principle of chemical equivalency. (4) The liquid-liquid extraction technique affords a means for establishing some ion species. (5) The ion species of a particular element present during extraction may change as the result of equilibrium changes, particularly change in aqueous solution pH. (6) Aqueous phase pH is probably the major variable influencing the liquid-liquid extraction process when using organo-phosphates. (7) The optimum pH value for the extraction of metals by organo-phosphates appears to increase as the basicity of the metal increases.

The authors wish to emphasize the hazard of drawing any firm conclusions from the limited amount of data presented. The liquid-liquid extraction technique is relatively new. The present high interest in the process is understandable in view of the success of the liquid-liquid extraction operation as applied to the winning of uranium. It must be borne in mind, however, that this also involves a product in the \$8 to \$10 per lb range. Reagent costs, or at least reagent losses, must be greatly reduced before the liquid-liquid extraction process will be economically attractive for other than the high-priced metals. However, the fact that the technology of this process is applicable to many other metals opens a new and fertile field for research and development. If the past may be used to forecast the future in this field, it sounds reasonable to expect that liquid-liquid extraction processes will find important applications in the winning of metals other than uranium.

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As Viewed by HARRY L. MOFFETT of the American Mining Congress

As this is written the President is in Paris attempting to shore up the creaking NATO alliance which has been under Soviet propaganda bombardment for several weeks. While Mr. Eisenhower and the heads of allied nations are threshing out the problem of how to compose their own differences and to deter the Reds from World War III, the home front continues to resound with criticisms of U. S. defense progress, particularly in the international race to gain control of outer space.

Administration officials are putting the finishing touches on the new Federal budget and the legislative program to be submitted to Congress early in the next session.

Members of Congress are returning to Capitol Hill from the hustings armed with the views of their constituents as to major legislative proposals. From the time the gavel is hammered down on January 7, signaling the opening of the new session, until adjournment this summer, debate on every national issue before the Congress will be colored with political overtones. Sights of the legislators will be trained not only on the immediate national problems but also on the issue of how to gain control of the next Congress for their particular party.

LABOR PROGRAM UNVEILED

Secretary of Labor James P. Mitchell unveiled the Administration's proposals for labor legislation at the annual convention of the AFL-CIO in Atlantic City early in December. His address, announcing the proposals, was undoubtedly designed to placate labor in the face of the revelations of the Senate Rackets Committee and the growing chorus of demands for stringent revision of labor laws.

The negative statements he made were as important as the positive proposals which he advanced. He told labor "we will not recommend a so-called national right-to-work law and we will oppose such legislation if it is proposed." He also expressed the Administration's opposition to appli-

cation of the anti-trust laws to unions, and to any change in the present law prohibiting use of union dues for political purposes.

On the positive side Mitchell took some mild slaps at union corruption and tossed out some warmed-over proposals for revamping the Taft-

Hartley Act.

The Administration labor proposals would (1) require registration, reporting and public disclosure of the operations of all health, welfare and pension plans whether financed by unions, employers or jointly; (2) require all labor organizations to file financial reports with the Department of Labor: (3) require unions to file with the Department reports with reference to procedures on election of officers, calling of meetings, levying of fines, and authorization for dis-bursement of funds; (4) require reports by employers on any payments to employee representatives, and make it a felony for employers or union officials to make or receive payments to influence the actions of either; (5) empower the Secretary of Labor to investigate the accuracy of union reports, and provide for fines and jail sentences for false statements and for Federal prosecution of union officials for embezzlement of welfare or other union funds-providing that in such cases unions would lose their collective bargaining status under the Taft-Hartley Act as well as their tax-exempt status; and (6) create a Commission of Labor Reports to handle the union and employer reports just outlined.

As to amendment of the Taft-Hart-ley Act, Mitchell said the Administration will seek a prohibition on secondary boycotts which are intended to force an employer to stop doing business with others, a tightening up of the present law's picketing provisions, elimination of the statutory provision which bars economic strikers from voting in representation elections, a closed shop for construction workers, and elimination of the present law's non-communist affidavit requirement.

Meanwhile, Senator McClellan has

Washington Highlights

CONGRESS: Begins new session.

LABOR PROGRAM: Announced by Labor Secretary.

TRADE AGREEMENTS ACT: In for hot fight.

REVENUE REVISION: Sharp tax cuts unlikely.

OIL IMPORTS: New curbs coming?

COAL WAGE: Revised minimum rates sought.

announced that his committee will have an interim report ready early next year. He stated that Congress will be urged to act on a number of proposals to "clean up the mess" disclosed as a result of the Committee's investigations to date. He suggested these possible solutions: (1) enactment of a code of basic standards and requirements for conduct of union affairs; (2) adoption of a requirement that welfare, pension and union funds be trust funds; (3) a law to hold union officials accountable for funds in the same manner as managers of banks or insurance companies, and (4) denial of tax exemption to unions failing to comply with standards of accounting, conduct, and ethics prescribed by law.

TRADE PACT BATTLE OPENS

Another of the Administration's major legislative proposals which has been disclosed to the public—a fiveyear extension of the Trade Agreements Act—is in for one of the stiffest fights ever seen on Capitol Hill. Sentiment for protection of numerous American industries has risen to a new high in the past months and strong demands are being made for tariff relief. Apparently cognizant of this, the Administration has start-

ed an organized campaign aimed at convincing the American public that our foreign trade policy is a necessary instrument to maintaining cordial relations with our allies.

Details of the Administration trade proposals were revealed jointly by the Commerce and State Departments. They said the President will call upon Congress for (1) authority to reduce tariff rates by five percent annually for five years or to reduce a duty by 25 percent over a three-year period if no yearly reduction is for more than 10 percent; (2) authority to cut any tariff rate to 50 percent ad valorem if an existing duty is in excess of that amount; (3) power to reduce existing rates by 3 percent ad valorem, with no yearly reduction exceeding 1 percent, in cases where the existing rates are already small; and (4) increased authority to raise duties up to 50 percent of the rates in effect on July 1, 1934 whenever an "escape clause" investigation finds duty increases necessary to remedy serious or threatened injury to a domestic industry. It was also disclosed that the President will seek power to institute escape clause proceedings immediately after "peril point" investigations disclose that existing rates of duty threaten or cause serious injury, rather than delay such proceedings until after the President has attempted to negotiate increases with foreign nations.

On the heels of the announcement of these legislative goals, the Commerce Department was given the task of championing them publicly. Secretary Weeks established a 60-member World Trade Advisory Committee composed of prominent businessmen to advise the Department "in formulating policies and programs promoting international trade, travel, and investment." Many observers predict that the real job of this group will be to sell the Administration's proposals to industry and the public.

Meanwhile, a House Ways and Means subcommittee, headed by Rep. Hale Boggs (Dem., La.), has held public hearings on the conduct of foreign trade. Witnesses have made many suggestions, ranging from recommendations for an 11-year extension of the present law to junking of the trade act and its replacement with adequate tariff protection for domestic industries.

From House Speaker Sam Rayburn has come this prediction—extension of the Act after "a whale of a fight."

On the administrative front, the Tariff Commission has received final briefs in its investigation of the plight of the domestic lead-zinc industries, and is expected to make its recommendations known shortly. Predictions are made that the President will approve recommendations for higher duty rates on lead and zinc.

Meanwhile, the Commission continues its study of comparative labor rates between domestic and foreign producers of tungsten and the effect of imports upon U. S. mining companies. The Commission has not indicated when its report will be ready for Congress.

REVENUE HEARINGS OPEN

Hearings on general revenue revision before the House Ways and Means Committee begin January 7 but the prospect for any significant tax reduction is very dim. The hearings are scheduled to run for 24 days and the list of witnesses is expected to be very large.

It is understood that the Committee will ask Treasury Secretary Robert Anderson, Defense Secretary Neil McElroy, Federal Reserve Board Chairman William McChesney Martin, and Budget Director Percival Brundage to testify early in the hearings and point up the tax picture with respect to the budget and defense requirements. Their appearance may be delayed until after the new budget is submitted to Congress in order to avoid premature disclosure of confidential information.

Recently, Administration aides made it plain that the President will seek another extension of the present 52 percent corporate tax rate and current excise tax rates on cigarettes, liquor and automobiles which are due to expire June 30. What other tax provisions the Administration may seek have not yet been disclosed.

While the Administration has been stating that it hopes to maintain a balanced budget in the next fiscal year, Rep. Wilbur Mills (Dem., Ark.), a ranking member of the Ways and Means Committee, has declared that he anticipates a budget deficit in the present fiscal year and again next year if non-defense spending is not cut sharply. He has said that the bitter realities of inflation and Soviet scientific advances weigh against a tax reduction.

On the other hand, House Minority leader Martin (Rep., Mass.), while agreeing that there may be no substantial tax reduction voted at this session, said that certain tax abuses may be corrected. It is understood that he was referring to possible passage of the Mills bill which is designed to remove unintended benefits and hardships arising out of the 1954 Revenue Code. Prospects for approval of this measure, which carries several provisions of importance to the mining industry, are fairly bright.

OIL IMPORT REVIEW ORDERED

ODM Director Gordon Gray is taking a close look at imports of residual oil with a view to determining whether the agency should impose voluntary curbs in this field. He has directed importers of residual oil to

submit monthly reports of actual and planned imports for five successive months in order that the Government can study the extent and effect of such imports. The first report was rendered on December 16, 1957. Results of that report have not yet been announced.

Another decision as to oil imports is in the offing. The Cabinet Committee on Crude Oil has before it recommendations of Captain M. V. Carson, Oil Imports Administrator, as to possible restrictions upon West Coast crude oil importers. What the recommendations are have not been disclosed, although it is known that Carson favors some curbs on such imports.

COAL MINIMUM WAGE RATE HEARING ORDERED

Labor Secretary Mitchell has scheduled a public hearing for February 3 in Washington on a proposal to amend the determination of the prevailing minimum wages in the bituminous coal industry. The hearing is a result of a petition filed by both labor and management representatives last October requesting a redetermination of prevailing wages.

The coal industry and labor petitioners had told the Labor Department that their collective bargaining agreements have resulted in increases in the wages of employes in the industry, and that there has thus been an increase in the prevailing minimum wages which should be reflected upward from the determination made by the Labor Department in late 1955.



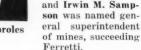


"Ed's been a mining lease hound for 20 years."

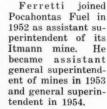


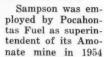
Several executive changes were recently made by the Pocahontas Fuel A. Vernon Sproles, who had been

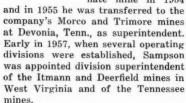
vice-president in charge of operations for the large producer of bituminous coal, was elected executive vice-president. P. P. Ferretti succeeded Sproles as vice-president in charge of operations A. V. Sproles



Sproles is a veteran of over 48 years service with Pocahontas Fuel and a predecessor company. He became vice-president in 1954 after serving ten years as general superintendent of mines.







The Portland Cement Association has announced election of four new members to its Board of Directors.

The four are Eugene D. Hill, president, Louisville Cement Co., Louisville, Ky.; C. T. Fuller, vice-president, Allentown Portland Cement Co., Allentown, Pa.; B. B. Pelly, vice-president, Olympic Portland Cement Co., Ltd., Seattle, Wash., and L. T. Welshans, general manager of the Cement and Coke Division, Standard Portland Cement Division, Diamond Alkali Co., Cleveland.

On December 1, Jack S. Whittaker was appointed vice-president of Pittsburgh Coal Co., Division of Pittsburgh Consolidated Coal Co. Earlier, J. R. Palin was named assistant chief engineer of the company.

Two personnel changes have been made at the Eagle Picher smelter at Henryetta, Okla. John Wade, who has been manager of the chemical division plant of Eagle Picher in Hillsboro, Ill., will become plant manager at Henryetta. Charles Condren, who has been acting plant manager, has been named superintendent of the furnace department.

The board of directors of Bell and Zoller Coal Co. have appointed Roland Wilson vice-president in charge of production,

United States Fuel Co. has announced the election of F. S. Mulock to the post of chairman of the board. Oscar A. Glaeser, vice-president, succeeds Mulock as president of U.S.





F. S. Mulock

Fuel. Mulock is also president of the United States Smelting Refining & Mining Co. and Glaeser continues as vice-president and general manager of Western Operations of the com-

Glaeser started with U.S. Fuel over 21 years ago as safety and ventilation engineer. He progressed steadily in the company and in 1954 was named vice-president.

Clinton C. Cornelius, formerly vicepresident of operations with the Baton Coal Co., was named general manager of United States Fuel.

AMC Mechanization Engineer Retires



Glenn B. Southward



George W. Sall

Glenn B. Southward, mechanization engineer with the American Mining Congress for the past 31 years, retired December 31. Honored at the recent AMC Coal Division luncheon in Pittsburgh (see page 57), he takes with him the best wishes of his many friends in the industry.

Glenn joined the Mining Congress in late 1926 to investigate and correlate the knowledge that had been gained about the then new-born art of mechanical coal loading, and to make the industry aware of the benefits of mechanized mining.

As the impact of mechanization increased, he broadened his activities to take in coal preparation, ventilation, underground power, roof control, haulage and all other phases of modern coal mining. He was the guiding light behind the organization of the Coal Division with its Committees meeting periodically to study and report on new developments in mining methods and equipment in an effort to achieve greater efficiency and safety. He has also been responsible for the organization of the technical programs at the AMC Coal Conventions, and has written many authoritative articles for the mining and industrial press.

The new mechanization engineer will be George W. Sall. Formerly assistant mechanization engineer and still managing editor of MINING CON-GRESS JOURNAL, he has gained a keen insight into the problems entailed in coal production and will ably carry on the work of advancing the science of coal mining.

George McCaa, in charge of the Ireland operation of Pittsburgh Consolidation Coal Co. at Cresap, W. Va., is the new president of the West Virginia Coal Mining Institute. He succeeds C. R. Nailer, president, Christopher Coal Co.

R. E. Shreve has been appointed mill superintendent at the Shiprock, N. M., uranium processing mill of Kerr-McGee Oil Industries, Inc.

Eugene P. Pfleider, professor and chief, Division of Mineral Engineering, School of Mines and Metallurgy,



E. P. Pfleider

University of Minnesota, will be visiting Professor in the Division of Mineral Engineering in the School of Mineral Sciences, Stanford University, Stanford, Calif., from January 1 to June 15. During this period Dr. D. H. Yardley will be

acting chief of the Division of Mineral Engineering at the University of Min-

Arnold C. Saunders, Jr., retired as vice-president of the Lorain Coal & Dock Co. on January 1. However, he continues to serve on the board of directors.

After some 34 years of service with Brittania Mining & Smelting Co., Ltd. and Howe Sound Co., George C. Lipsey has resigned as vice-president and general manager.

Lipsey joined Britannia and the Howe Sound Co. in 1924 and in 1937 was appointed general superintendent of the Chelan Division of Howe Sound Co. at Holden, Wash. He brought the mine into production in 1938. During the past two years he has been in charge of Canadian operations.

Anthony M. Gentile has been named manager of the Ohio Collieries Co. succeeding Fred Howe, who resigned. Ohio Collieries' strip mine supplies coal for the Phillip Sporn power station at Graham Station, W. Va., and the Kyger Creek plant at Cheshire.

Howard Lee Young, vice-president, American Zinc, Lead & Smelting Co., has been elected to the board of directors to fill the vacancy caused by the recent death of Erle V. Daveler. Young, who has been with the company since 1937, was elected vicepresident and manager of sales in 1955.

At the same time it was announced Thornton Emmons, vice-president and director retired from active duty on January 1. He continues as a consultant and as a director of the company.

C. Ray Huffman, industrial sales manager and a veteran of 34 years with Monongahela Power Co., retired from active service with the utility company December 1. He immediately assumed duties as consulting engineer with Maust Coal & Coke Corp. He will be located in Richwood, W. Va., in the offices of a Maust affiliate, the Donegan Coal & Coke Co.

Harry M. Feigin, property superintendent of the Florida department of the Phosphate Minerals division of International Minerals and Chemical Corp., has been appointed to the new position of coordinator of organization planning.

Norman Yarborough, with the Coal Division of United States Steel Corp. at Lynch, Ky., has been elected president of the Kentucky Mining Institute.



F. Ray Friedley, 54, comptroller for Oliver Iron Mining Division of U. S. Steel Corp., died November 1.

Formerly assistant comptroller at Salt Lake City for the Utah operations of Columbia Geneva Steel Division, Friedley was appointed comptroller of Oliver August 1.

Albert St. Vincent, 75, former general superintendent of the Hibbing-Chisholm District for the Oliver Iron Mining Division of U. S. Steel Corp., died November 13. Mr. St. Vincent joined Oliver in 1898 as a blacksmith helper and served in many capacities until he was made superintendent in 1928. He was superintendent of the famous Hull-Rust Iron Mine at Hibbing, Minn., for 15 years before retiring in 1947.

Thomas Robins, 89, founder and former chairman of Hewitt-Robins, died November 4 after an illness of several months.

Mr. Robins founded the Robins Conveying Belt Co. in 1896. The company was merged with the Hewitt Rubber Co. in 1945 to form Hewitt-Robins.

George H. McFadden, 69, died in Evanston, Ill., December 1.

Long active in coal industry circles, Mr. McFadden was a mine superintendent for a number of Illinois operators, and a member and vice-president of the consulting mining engineering firm of Paul Weir Co. for the last 18 years.

William Edward Barrow, 77, president of Joy Manufacturing Co. from 1934 until 1940, died October 28 in Franklin, Pa.

Honorable Augustine B. Kelley, member of the House of Representatives from Pennsylvania, 74, who was owner of the Mammoth Coal & Coke Co., died in Washington, November 1, 1957.

Mr. Kelley was well-known among members of the coal industry and supported legislation beneficial to it. As second ranking Democratic member of the House Committee on Education and Labor, he was active in connection with labor matters.

Sir Ernest Oppenheimer, 77, South African mining magnate and one of the world's richest men, died November 25.

As chairman of the Ango-American Corp., Sir Ernest played a leading part in developing South Africa's rich gold fields. He was also chairman of De Beers Consolidated Mines, Ltd., which brought stability to South Africa's diamond mining industry and brought him the title of the world's diamond king.



R. S. Newl



T. A. Campbell



C. M. Brinckerhoff

Several changes in executive personnel have been announced by The Anaconda Co.

Richard S. Newlin, vice-president in charge of Anaconda's mining operations since 1952, has been elevated to the position of vice-president in charge of operations. Thomas A. Campbell, vice-president of the company since 1956, assumes additional responsibilities in his election to the newly-created post of vice-president for Latin-American affairs. Charles M. Brinckerhoff has been elected executive vice-president of Andes Copper Mining Co. and Chile Exploration Co., both Anaconda affiliates.



Eastern and Central states

L. C. CAMPBELL RETIRES

Luther C. Campbell, vice-president of Eastern Gas & Fuel Associates, retired from that post November 30. He plans to remain active in coal mining as a consultant at headquarters which he will open in Pittsburgh, Pa.

A graduate of Penn State Univer-



L. C. Campbell

sity, Campbell has been associated with mining for 42 years. He was first employed in 1915 as superintendent for the Rand Mining Co., a gold and silver mining organization in Nevada. Later he became superintendent and then general superintendent of the coal mining operations of McKinney Steel Co. in Pike County, Ky.

His employment with Eastern Gas & Fuel Associates and its predecessor organizations dates back to 1927 when he became general superintendent for the Melcroft Coal Co. and later for the Elkhorn Piney Coal Mining Co., both of which later became a part of the Koppers Coal Co., now the coal division of Eastern Gas & Fuel Associates. He was appointed assistant to the vice-president of Eastern in 1934, general manager of mines in 1941, and was elected vice-president in 1943.

Throughout his mining career, Campbell has been active in the mine safety movement. For many years he has been management representative on the Coal Mine Inspection Advisory Committee which cooperates with the U. S. Bureau of Mines in promoting safety in coal mining by advising in connection with the Federal Mine Safety Code.

Campbell has played a major role in the many activities of the Coal Division of the American Mining Congress to make mining a safer and more efficient industry. He has been chairman of the Coal Division since 1951 and at the recent annual meeting of the Mining Congress he was reelected to that position.

Campbell also served four terms as president of the National Coal Association (1952-56) and is now an NCA director and member of its executive and finance committees. In addition, he is a director of Bituminous Coal Research, Inc., as well as numerous other national and regional engineering and mining group.

One of his latest undertakings is national chairman of a committee to raise financial support to establish a major coal research center in Pittsburgh.

Virginia Titanium Plant Opened

A new plant for the processing of titanium ores has been opened at Montpelier, located in western Hanover County, Va. The plant is owned by Metal & Thermit Corp. H. E. Martin, president, said the plant, exploration and equipment had cost about \$1,250,000.

Company officials estimated the plant will produce about \$500,000 worth of rutile in 1958 and 1959 and thereafter about \$1,000,000 worth each year plus about \$100,000 worth of ilmenite per year. Rutile is the source of the lightweight, corrosion-resistant titanium metal. Ilmenite is a source of white pigment for paints, plastics, rubber and textiles.

It has been estimated that the supply on the 800-acre tract should last 20 years, depending upon market conditions.

E. J. Longyear Co.

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IN WESTERN STATES

Pattin expansion shells are available and serviced exclusively by Colorado Fuel and Iron Corporation, Denver, Colorado. Western mining companies should contact them di-rect for information and consultation.

PATTIN split-type BOLT

The split-type bolt is one of the first slotted belts, and continues to be a favorite wherever split-type bolts are used. Many mines still pre-fer this type. The bolt is a full 1-inch in diameter, with cut threads and furnished with hex or square nuts and various size plates and

The PIONEER of roof bolting . . . established 1888

Gold Mine Started

Announcement was made recently that operations have started on South Africa's biggest and most expensive gold mining enterprise, located about 50 miles west of Johannesburg. More than \$56,000,000 will be spent on the new mine.

The Western Deep Level Mine will be 12,000-ft deep and is expected to produce 800,000,000 lb of gold during its estimated 60-year life span. It will take over six years to bring the mine to full production.

Doing It the Hard Way

America is familiar with the concept of the coal miner as a worker deep underground, but early Alabama miners worked under water. That was more than a century ago, when about 200 skin-diving miners worked coal seams in the bed of the Black Warrior River 50 miles upstream from Tusculoss.

The submarine coal miners were re-corded in the first biennial report of the Alabama Geological Survey in 1850. Michael Tuomey, reporting on observations made the previous year,

1850. Michael Tuomey, reporting on observations made the previous year, wrote:

"At the mouth of Village Creek... I witnessed here the novel process in the art of mining, namely, diving for coal. A flatboat is moored parallel with the joints, and near the edge of the coal long wedge-shaped crowbars are driven into the seams by means of mauls maneuvered by the men in the boat. When a ledge of about two ft is loosened in this way across the seam, the men take to the water and dive two or three together... and lift the coal bodily to the surface and place it in the boat."

Tuomey said as an improvement on this method chains were slipped around the loosened blocks of coal and they were hoisted aboard by cranes. Some lumps weighed 800 to 1000 lb.

The report said this was one of the cheapest ways of producing coal despite the "primitive appearance" of the method. The flatboats held about 2000 bushels each and drew 20 to 30 in. of water.

Most of the miners were farmers

2000 bushels each and drew 20 to 30 in, of water.

Most of the miners were farmers who could only work at mining in August, September and October. Their product was floated down river when rains made the river navigable. It was sold in Tuscaloosa at 10 to 12 cents a bushel—about \$2.50 to \$3 a ton—or floated on to Mobile at an extra cost of about four cents a bushel. The flatboats, which cost about \$70 each, were sold at a loss, bringing only a few dollars since they could not be brought upstream again.

be brought upstream again.

Orefraction Opens Plant

Formal dedication ceremonies were held recently for the new plant of Orefraction Minerals, Inc., located at Andrews, S. C. The new plant will process zircon, ilmenite, rutile and monazite.

Company officials said that over \$600,000 had been invested in the plant which is located on a 25-acre site. Most of the 25 acres are unused and may be utilized for expansion purposes later.

Increase Cement Capacity

Universal Atlas Cement Co. has awarded a contract to Rust Engineering Co., Birmingham, Ala., for new construction at its Leeds, Ala., plant which will substantially boost cement production there.

Charles B. Baker, president of this U. S. Steel subsidiary, reports that the contractor will begin work immediately on installation of a finish grinding mill and supporting facilities for the production of portland slag cements, both regular and airentraining types. It is estimated that the new construction will be essentially completed in the latter part of 1958.

Portland slag cements are mill-ground combinations of portland cement clinker, granulated blast-furnace slag and other essential ingredients. They have physical properties similar to those of equivalent types of portland cement and are suitable for the same general uses. Four of the eleven plants of Universal Atlas are now manufacturing portland slag cements—at Universal, Pa., (near Pittsburgh); Buffington, Ind., (near Chicago); Milwaukee, Wis.; and Duluth, Minn. A fifth plant, at Hudson, N. Y., (near Albany), will start production of portland slag cements early in 1958.

The original Leeds plant, located about 18 miles east of Birmingham, was built in 1906. It was replaced in 1938 and, in many of its facilities, has since been modernized for the purpose of better serving its customers throughout the Southeastern states.

Ohio Tops Coal Record

Figures released from the Ohio Department of Industrial Relations recently indicated that Ohio's coal production in 1956 was the highest in the past 33 years. The coal report was part of a general mineral-extraction industry report which showed that the State's mineral production added \$300,000,000 to Ohio's wealth during 1956.

The report said that 40,000,000 tons of coal were mined in 1956 with a majority of it coming from Harrison, Belmont and Jefferson Counties. These three counties accounted for over half the State's coal tonnage. Officials estimated that four billion tons of coal have been mined in Ohio and that about 20,000,000,000 tons of recoverable reserves remain.

The average monthly employment for coal miners was 40 percent below that of ten years ago but the 1956 payroll, of more than \$51,500,000, was 19 percent above that for 1946.

In addition to coal the report included oil and gas leases, sand, gravel, sandstone, clay, shale, gypsum and

Anaconda Plans Acquisition

Announcement was made recently by Archibald P. Cockran, president of the Cochran Foil Co., that the officers of the company have agreed to a plan, subject to stockholder approval, effecting the acquisition of the company through an exchange of stock by Anaconda Co.

The Cockran firm, located in Louisville, Ky., produces aluminum foil and sheet and it is expected that the plant will be supplied from Anaconda's primary aluminum facility in Montana.

Britain Faces Coal Shortage

An energy gap of 95,000,000 tons of coal equivalent a year by 1975 was predicted for Britain recently by Sir John Crockcroft, director of Britain's Atomic Energy Research Establishment in a speech at Harriman, N. Y.

Cockcroft said that the gap can be filled only by increasing oil imports and by nuclear energy. He said that nuclear power in Britain may cost ten percent more than coal power in 1960 but by 1970 it may be 30 percent cheaper than coal.



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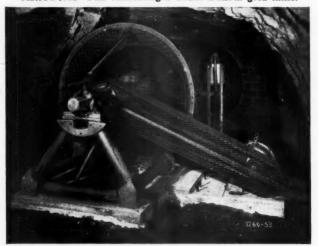
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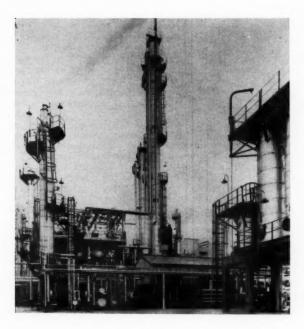


AERODYNE® Fan installed underground in an iron mine.



AERODYNE® Midget Blower serving a potash mine in the West.

J & L Produces Coal Chemicals



First production of pure coal chemicals in the steel industry has been announced by Jones & Laughlin Steel Corp. A new plant at J & L's Aliquippa, Pa. works has started production of high-grade benzene, toluene, and xylene. A light oil containing these components is produced from the coking of coal to make metallurgical coke for the blast furnaces at J & L's three steelmaking plants in Pittsburgh, Aliquippa, and Cleveland.

The purity of these products exceeds the requirements of standard specification of the chemical and allied industries. Coal chemicals of this higher quality are in demand for making many products, including synthetic fibers, synthetic rubber, insecticides, dyes, drugs, and other chemicals.

The plant has a rated capacity of 55,000 gal per day of light oil. At a cost of more than \$2,000,000, it combines the "Hydrofining" and "Udex" process which have been adapted to coal chemical purification.

Both of these processes are advanced refining which not only improve product quality over that possible with the processes formerly used, but increase quantities recovered as well.

Purity of the final products is indicated by the fact that sulphur compounds are reduced to less than one part per million.

The Hydrofining process utilizes a catalyst to promote a reaction between sulphur compounds and hydrogen. The hydrogen also combines with some of the non-aromatics in the oil to produce compounds that can be separated from aromatics in the Udex process. Hydrogen for the process is produced by ammonia dissociation units. The Udex process utilizes a glycol solvent with a strong preference for aromatic hydrocarbons in a countercurrent extraction column of special design.

A major feature of J & L's new refining process is the ability to separate the benzene, toluene, and xylene as high-purity products without making intermediate materials.

The Mining Industry
Passes in Review in the
FEBRUARY ISSUE

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TV Used for Safety

The use of television as a safety device for miners digging ore more than 1000 ft below the surface of Red Mountain, near Birmingham, Ala., was announced recently by Tennessee Coal & Iron, a division of U. S. Steel.

The television cameras have been used at the 1030-ft level of the Wenonah No. 11 mine with monitors located 75 ft above them. The cameras can operations at a rotary dump yard and pass the pictures back to the monitors. The cameras can be automatically swiveled so as to give the dump operators a complete view of the yard.

In the dump yard, loaded ore cars are automatically picked up and emptied into surface bound skip cars prior to being placed back on the tracks and sent after another load of ore. A signal system was used formerly to halt operations in the event of trouble. Television is being used to replace the older signal system.

The entire dump area within camera range has been whitewashed to improve the quality of the TV picture. The operations are observed on TV screens of more than 400 lines. Most commercial sets have less than 400 lines.

Kentucky Coal Canal Opened

An 1800-ft canal for the transport of coal from a River Queen Coal Co. mine to the Green River in Kentucky has been completed by the company to expedite coal shipments to utility plants in the Ohio Valley.

The canal, which is capable of handling 16 barges, is 400-ft wide and provides a route to the Green River which flows into the Ohio River. The River Queen mine is located in Muhlenberg County, Ky.

The coal which is stripped from Muhlenberg hills, is passed over an automatic sampler, a "weightometer" which weights the coal as it goes over conveyor belts. It is washed and moved into a 96-ft silo, which holds 4000 tons, for blending. Railroad cars then carry the coal the 6½ miles to the canal for loading into barges.

Philadelphia Ore Imports Up

More than 60 percent of the steelmaking capacity of the Eastern Seaboard is located within 100 miles of Philadelphia, but even more remarkable is the rapid rise of the Philadelphia area in the receipts of foreign iron ore, according to Max D. Howell, executive vice-president of the American Iron & Steel Institute.

Speaking at a recent regional meeting of his organization, Howell said, "six years ago such imports totaled less than 1,000,000 net tons annually.

Last year more than 10.6 million tons of iron ore entered this country through Delaware River ports."

Howell said the growth of steel production in the eastern district far exceeded the national average growth of the steel industry. He said the production in the eastern district in 1957 will be about 96 percent higher than the output in 1946, while the steel production of the entire country will be up about 71 percent over the same period.

Titanium Plant Produces

First production was reported recently from the Titanium Metals Corp. of America's titanium plant at Toronto, Ohio, north of Steubenville. It is reported to be the world's only plant devoted exclusively to rolling and forging titanium metal.

The new plant has facilities for production of sponge metal through forgings and billets and later alloy sheet production will be included. It is a joint operation of the National Lead Co. and the Allegheny Ludlum Steel Corp.

A company announcement said that sizeable amounts of titanium are scheduled for civilian aircraft programs and an increasing interest in titanium is being shown on the part of missile designers.

Poland Plans Coal, Sulphur Projects

Two major industrial projects valued at over \$126,000,000 will be started in Poland next year, according to recent reports. Included is the development of a huge new lignite mine and construction of the country's largest electric generating station. Exploitation of extensive sulphur deposits is also planned.

Located near the village of Turow in the southwestern corner of Poland, the brown coal lies 197 ft underground and it is believed that the reserves amount to one billion tons, or enough for 50 years exploitation. Some 130 ft lower there is a second layer, 82 to 98-ft thick. The brown coal will be used to supply the electric generating station which is located near the mine. One brown coal mine at Turow, which is to be expanded, is already producing about 5,000,000 tons per year and it is estimated that the mines combined will eventually produce about 20,000,000 tons per year.

The sulphur deposits extend to a depth of 195 to 260 ft and are located in southeast Poland. They are said to comprise more than 95,000,000 tons of pure sulphur. Plans for a scheme to be worked jointly with Czechoslovakia provide for an estimated future output of 350,000 tons of sulphur a year.



The Greensburg 8 ton Monitor is equipped with two glass insulated motors, contactor type controller and double equalizers. These double equalizers make the difference in performance . . . more tractive effort, better brakes, better riding qualities and longer battery life than any other storage battery locomotive of equal weight and battery capacity!

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Civil Engineering Building at Michigan Tech

Michigan Tech dedicated its new \$1,600,000 civil engineering and geological engineering building recently with the dedication address being given by Grover C. Dillman, president of Michigan Tech from 1925 to 1956.

Largest building on the campus, the new civil-geological building contains over 1,000,000 cu ft. It is the first new classroom and laboratory build-

ing since 1932.

An outstanding feature of the new building is its hydraulic laboratory, extending through three floors with a stand pipe 65-ft high. Included in the hydraulic lab facilities are four centrifugal pumps, a 56-ft long plexiglass-walled flume, a basement storage tank, weir boxes, and weighing tanks to 25,000-lb capacity.

Other engineering facilities include analysis and design laboratories, photogrammetry facilities, materials testing laboratory, facilities for analysis of bituminous materials, soils, and cement, structural laboratory, and a sanitary engineering labora-

tory.

Geological facilities, located on the third floor, provide additional laboratory facilities for geochemistry, paleontology, mineralography, mineralogy, petrology, economic geology, and lapidary studies.

Constructed of brick and reinforced concrete, the building is embellished with Indiana oolitic limestone, Minnesota pearl granite, Tennessee limestone, and black Belgium marble.

Will Seek Bauxite in Jamaica

Harvey Aluminum soon will begin prospecting for bauxite on government-owned lands in Jamaica. The company now is readying its 54,000-ton reduction plant at The Dalles, Ore., for production.

As a result of negotiations between government and Harvey officials, Jamaica has reserved all government-owned lands throughout the 4411 sq mile British colony exclusively for bauxite prospecting by Harvey Aluminum for the next three years.

Taconite Stored in Ohio

Over 93,000 tons of taconite are being stored at Lorain, Ohio, by the Republic Steel Corp., pending need for the ore at company plants in Youngstown, Warren, Canton and Massillon, Ohio. The ore was shipped earlier in the year from Silver Bay, Minn.

The iron content of the pellets is approximately 67 percent as compared to 50 percent in high-grade iron ore. A spokesman for Republic Steel said that this is the first year his company has used taconite extensively.

New Industry Established in Pennsylvania

Fine particles of coke, thrown away for years as worthless by steel companies, are now being salvaged in western Pennsylvania. The coke is sintered in much the same way that low-grade iron ore is sintered and made usable for steel-making.

Fine coke was discharged from beehive coke ovens that still dot the area and were a main source of coke for the steel industry for 80 years. This discharge was placed in huge piles as worthless. It is estimated there are between 20 and 25 million tons of the refuse coke in western Pennsylvania alone and that more can be found in other parts of the country where the beehive coke ovens were once in use.

The Sinter Fuel Corp. operates five preparation plants in southwestern Pennsylvania. The preparation involves grading and washing of the coke with the sintering actually being done by the steel companies. D. H. Stern, president of the company, estimates that the recovered coke is six to eight dollars a ton cheaper than coke from by-product ovens, and says that current sales to steel companies are running around 200,000 tons per year. Another 100,000 tons is being sold annually to cinder block producers.

Helium Plant Possible

The Department of the Interior has recently approved plans for a new helium producing plant for the United States and has asked for Bureau of the Budget consideration.

Officials refused to disclose the possible sites being considered for the installation or to estimate costs, but they did confirm that the plant will be built "someplace" in the southwestern part of the United States. It has been estimated the plant will cost about \$14,000,000. No further information will be available until the Bureau of the Budget reports on the recommendation.

Ore Railroads Modernized

The Export-Import bank has advanced \$8,000,000 to Spain for the purchase of locomotive and signal equipment to be used in bringing iron-ore from the rich fields of Ponferrada to the seacoast. These fields are important earners of foreign currency for Spain, but poor rail communications have kept shipments down.

American diesel-electric locomotives and a central signal system will replace present inadequate equipment to provide better services from the Wagner and Vivaldi ore fields of Ponferrada to the ports of Corunna or Vigo, both of which are about 180 miles from the mines. It is believed that the installation of the modern

transportation facilities will increase the ore shipments to 3,000,000 tons of ore annually to Spanish and foreign destinations.

Arkansas Magnesium Search

Arrangements have been completed by the American Potash & Chemical Corp. to conduct exploratory investigations of manganese ore deposits near Batesville, Independence County, Ark., according to Peter Colefax, president of the company.

The mineral rights to the deposits are held by the U. S. Manganese Corp., Arkansas Mining & Exploration Co., Miller-Lipp Corp. and Miller-McGee Manganese Corp., all Ar-

kansas concerns.

Colefax said that if the results of the investigations are favorable, present plans call for the formation of a new company to undertake commercial production, with American Potash holding 55 percent of the stock. The properties have been operated independently by the four Arkansas companies for the production of manganese ore.

BOOK REVIEWS

MINING OPERATIONS IN 1955

Department of Mines, Toronto, Ontario, Canada. A completely documented picture of the mining operations in Ontario during the year 1955 is presented in the latest report to be issued by the Ontario Department of Mines. The publication is ready for distribution by the Department and will be incorporated as Part 2 of the Annual Report for 1956.

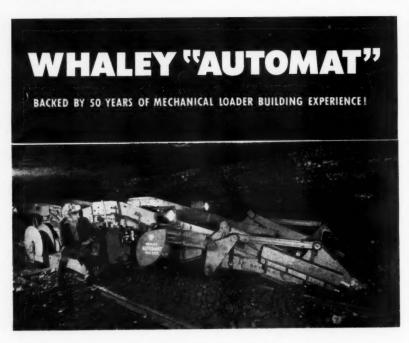
More than 100 mines are covered in the factual report of operations and such development work as shaft sinking and drifting is summarized in most cases. The operations of eight metallurgical plants are also summarized.

ASTM STANDARDS ON COAL AND COKE, American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 140 pages, \$2.50.

This is a convenient compilation of the numerous ASTM methods of testing, definitions, and specifications for coal and coke, and the standard specifications for the classification of coal according to rank and grade. Previous editions have been widely used in connection with the evaluation and purchase of coal and coke. This edition contains 21 methods of test, four specifications and three definitions. Of these, four are new or recently revised.

The 6 by 9-in. paperback book is of interest to importers and exporters of solid fuels, utilities, transportation companies, and process industries which have their own power facilities.

Making enviable record for Capacity-Loading



WHALEY "AUTOMATS" like the ones pictured have been called "The Workhorse of the Mining Industry." An appropriate term based on the "Automat's" enviable record for capacity-loading (Maximum 766-Tons in one shift in coal). This vitality through three-shift operations results from the machine's mechanical reliability. For a fact, it has been claimed the Whaley "Automat" is designed and built to capacity-load forever. When you consider the job being done today by "Automats" 20-years old and more, not just in soft coal, but in tough entry driving, for rock and slate handling, and hard rock tunneling, this durability at low upkeep makes the Whal-ey "Automat" the best load-ing machine investment for

Need your "Automat" track or crawler-mounted?

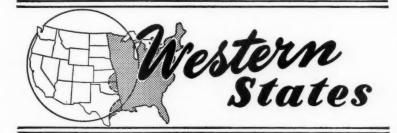


The crawler-mounted "Automat" offers you all the advantages of the track-mounted machine. Too, if you are presently equipped with "Automats," conversion to our Hydraulic Drive is available. One leading mine converted four "Automats." One thing for which you can be certain, be it track or crawler-mounted, for general work in coal, rock or ore, the YEARS HAVE PROVED there is no underground loader that can capacity-load continuously like the Whaley "Automat." Write us for complete literature and information. MYERS-WHALEY COM-PANY - also machine re-conditioners and rebuilders.

MYERS-WHALEY

"OLDEST BUILDERS OF UNDERGROUND LOADING MACHINES"
MYERS-WHALEY COMPANY, KNOXVILLE, TENNESSEE, USA

The WORKHORSE OF THE MINING INDUSTRY



Lead-Zinc Mill Being Built

The Spokane mining firm, Utahcan, Inc., is constructing a 100 tpd lead-zinc mill at a new mining property west of Ione, Wash., about 25 miles south of the Metaline mining district of northeastern Washington.

Mill and concentrator equipment is being brought to the site from the Young America mine concentrator located in northern Stevens County, Wash. The latter property was recently purchased by Utahcan.

On the basis of estimated mining and milling costs, the firm expects the operation to be profitable even at the current low prices for zinc and lead.

Kennecott Emphasizes Efficiency

The Utah Copper Division of the Kennecott Copper Corp. announced recently a series of projects the company has had underway or planned to increase the operating efficiency of the company.

L. F. Pett, Division General Manager, said "for many years the emphasis has been on a maximum output. Now the emphasis must be on efficiency and lower costs; it's just good business."

One of the projects aimed at reducing costs is the construction of a \$12,000,000 ore haulage tunnel being driven from the mouth of Bingham Canyon to the bottom of the open-pit The tunnel will eliminate costly up-hill ore haulage from the bottom of the deepening pit and is expected to affect a considerable economy in the mining of low grade ore. The tunnel was started in November 1956 and is expected to be completed in 1960. It is approximately 35 percent complete now. It will be 31/2 miles long, 18 ft wide and 24 ft high and accommodate a single standard gauge railroad track.

In addition to the tunnel, engineering work has been started on an \$18,000,000 expansion at the Division's central power plant. The project will boost the total power output from 100,000 to 175,000 kw. It will include a 75,000-kw turbine-generator, new boiler, cooling towers, electrical switch equipment and a 20-ft extension to the present building.

Uranium Stripping Under Way

Vitro Minerals Corp. is removing more than 350,000 cu yd of overburden in developing its new open pit uranium mine in the East Gas Hills district of Wyoming. When the overburden is removed, the pit depth will range from 44 to 70 ft. The pit will measure 230 ft wide by 680 ft long and will be in a reverse figure "S" shape.

Sunshine Leases Land

The Sunshine Mining Co. has leased over 20,000 acres of land in Grant County, Wash., recently. The land is in the Frenchman Hills area and runs from Burke south to Vantage.

No definite plans for exploration

for oil or other minerals have been made, but it is reported that some geological studies of the area have been made.

Climax and American Metal Merge

Stockholders of the American Metal Co., Ltd., and Climax Molybdenum Co., have approved plan for the consolidation and merger of the two companies with American Metal as the surviving corporation under the name, American Metal Climax, Inc. Harold K. Hochschild will remain honorary chairman of the board. Arthur H. Bunker, president of Climax, is chairman of the board of the consolidated corporation. Walter Hochschild is vice-chairman of the board and chairman of the executive committee and of the finance committees; and Hans A. Vogelstein is president of the consolidated corporation.

Under the merger agreement, three shares of American Metal Climax, Inc., common stock will be issued for each 2,355,000 outstanding shares of Climax common stock but no shares are to be issued for the 225,000 shares of Climax common stock owned by American Metal. None of the 7,088,488 outstanding shares of American Metal common stocks were changed by the merger except for a change from no par value to a \$1.00 par value.



Borax Mine Dedicated

An adequate supply of boron to meet the needs of the entire free world for defense and industrial purposes through the next 100 years at the present rate of consumption—about 800,000 tons a year—was assured with the recent opening of United States Borax & Chemical Corporation's new \$20,000,000 open-pit mine and refinery.

More than 3000 persons were on hand November 13 to participate in the dedication activities at Boron, Calif. A symbolic "final" load of ore was hauled out of the mine by the famous 20-mule team which transported borax ore from the company's Death Valley mines in early California days. Then, James M. Gerstley, president of the corporation, set off a blast in the mine to signal the start of mining borax by the

open-pit method for the first time. J. F. Corkill, vice-president, was master of ceremonies and Under Secretary of Hatfield Chilson the principal speaker.

The new mine, which makes possible a virtual 100 percent recovery of ore, is 175 ft deep and exposes a deposit that contains more than 70 percent of the free world's supply of boron ore. Open-pit mining is expected to increase American production of boron by 30 percent.

Through its possible use as an ingredient in high energy fuels, boron is regarded as an important potential factor in national defense and missile development. There also are currently more than 100 different industrial uses of boron in the manufacture of such products as glass, ceramics, plastics, agricultural chemicals, pharmaceuticals, porcelain enamels and gasoline additives.

WHAT CAN RESEARCH DO

(Continued from page 34)

and steps can be taken to attune company operations and future strategy to such developments.

Some mining managements could use a metal economics service, a continuously current analysis of the effects of changing economic and technological developments on the potential of a metal or a group of metals.

Three Things Managements Can Do

The writer has tried to indicate some of the applications of research in the management area.

What can mining managements do about these new opportunities in research?

First, managements must look with critical eyes upon their own research departments and upon the men who head them. No longer can a research director in the mining industry be familiar with metallurgy, mining engineering, and chemistry alone. He must be willing to call upon all the professions to make sure that his company is using research in the broad sense possible today.

Second, managements, aware of modern trends in research in the management area, must communicate their willingness to have this type of research undertaken, outline their objectives, and insist that their own research departments be responsible for the initiation and conduct of such research programs.

Third, managements must require that their research departments keep their eyes on the future, as well as on the present. The "extra something" that can push a company ahead of its competition and keep it there is the systematic application of latest trends in scientific research to all phases of company operation.

Mining Association Elects

Russell Haworth of Carlsbad, N. M., was elected president of the New Mexico Mining Association recently, succeeding J. K. Richardson of Hurley.

The group also adopted a resolution urging control of metal and mineral imports to maintain a healthy domestic industry, favoring a sliding scale excise import tax on metals and metal products when the domestic price drops below the "peril point." The group also endorsed "right-to-work" legislation.

Other officers elected included T. O. Evans of Santa Fe, first vice-president; A. L. Greslin of Questa, second vice-president; and W. F. Darmitzel of Santa Fe as executive director. Directors elected or reelected included: James I. Craig of Hanover;

M. H. Bolton of Shiprock; T. M. Cramer of Carlsbad; J. C. O'Kelly of Carlsbad; L. W. Swent of Grants; J. E. Tong of Carlsbad; Mr. Richardson; E. C. Skinner of Carlsbad; W. Aubrey Smith of Carlsbad; J. A. Russell of Santa Fe; W. G. Word of Silver City, and L. H. Chapman of Vanadium.

Bunker Hill Acquires Idaho Mine

The Red Bird lead-silver mine near Clayton, Idaho, has been sold to Bunker Hill Co., Kellogg, Idaho. Bunker Hill reportedly has scheduled an extensive exploration program, including sinking of a shaft below the 900-ft level.



"That's okay, Doc, sometimes I have trouble finding a vein, too."

Utah Phosphorus Source Viewed

The nation's largest, but as yet undeveloped, deposit of phosphate rock was inspected recently by Governor Clyde of Utah, officials of the Federal Bureau of Reclamation, and executives of Stauffer Chemical Co., Western Phosphate, Inc., Mountain Copper Co., Ltd., and San Francisco Chemical Co. It is anticipated that the deposit, which is at Vernal, Utah, and only 19 transmission line miles from Flaming Gorge, may become a major source of phosphorous within the next few years and particularly so when the Flaming Gorge Dam, now under construction, is completed.

San Francisco Chemical Co., jointly owned by Stauffer and Mountain Copper Co., Ltd., holds exclusive rights to the huge deposit, which covers some 15,000 acres. Indicated phosphate rock reserves, averaging 21 percent P_2O_5 , approximate 700,000,000 tons. San Francisco Chemical has been proving up the deposit over the past several years by means of extensive core drilling and tunneling.

Stauffer is, of course, a major consumer of phosphate rock. Currently, it owns an open-pit phosphate mining project at Leefe, Wyo., which is operated by San Francisco Chemical. This

mine supplies ore to Stauffer's fertilizer plants at Los Angeles, San Francisco and Tacoma. It is also an ore source for Western Phosphate Inc. at Garfield, Utah, a company which is owned by Stauffer, American Smelting & Refining Co., and Kennecott Copper Co.

Indications are that the Leefe deposits can be profitably utilized for another 10 or 15 years. The Vernal deposit, which also can be open-pit mined, is being evaluated both as an additional raw material resource and as a future reserve.

To render the Vernal deposits economically utilizable, it would be necessary to build a beneficiation plant at the mining site, especially if the rock were to be shipped to customers at distant points. San Francisco Chemical has developed a beneficiation process which will upgrade the ore for either electric furnace or fertilizer use. This process has been utilized at Leefe, and it is anticipated that a substantial tonnage of the Vernal ore will be treated at Leefe in 1958 to prove out the beneficiation process.

Moreover, if power is available from the Flaming Gorge Dam, it would be feasible to locate electric furnaces at the mining site to create an integrated phosphorous-producing complex.

Merger Approved

Shareholder approval was received recently for the merging of three cement makers into one company. Shareholders of Riverside Cement Co., Los Angeles; Peerless Cement Co., Detroit, and Hercules Cement Corp., Philadelphia, cleared the way for the formation of the new company known as American Cement Corp.

The merger, which became effective December 31, results in a company ranking as one of the nation's half dozen largest. An estimated 87 percent of the outstanding stock in Riverside and Peerless was voted in favor of the merger and about 91 percent of the Hercules stock favored it.

The new company has eight million authorized \$5 par common shares with 4,113,615 outstanding.

Oregon to Get U-Mill

The Atomic Energy Commission has signed a contract with the Lakeview Mining Co., Lakeview, Ore., for purchase of uranium concentrates from a proposed 210 tpd mill costing about \$2,600,000. The new contract provides for the establishment of the first uranium mill in Oregon.

Construction of the Lakeview facility will start immediately, with completion scheduled in 12 months. The mill also will purchase, where available, amenable ores from independent producers in the area.

Utah Uranium Mill Completed

A new 800 tpd uranium mill has been completed near Mexican Hat in San Juan County, Utah, by the Texas-Zinc Minerals Corp. The firm is a joint affiliate of the Texas Co. and New Jersey Zinc. Co.

Development of the \$7 million mill has involved creation of a new road system, conversion of the Happy Jack mine in White Canyon to an open pit operation, extension by Utah Power & Light Co. and in part, by the company, of electrical transmission lines into a desolate area of the county and creation of a new town near the Utah-Arizona border.

Texas-Zinc plans a dedication ceremony for the plant in the forepart of 1958, according to A. L. Hayes of Grand Junction, Colo., president of the company.

To Exploit Large Deposit of Perlite

With the opening of its No Agua deposit of crude perlite in northern New Mexico as the first move, an extensive new expansion program has been gotten under way by the Perlite Department of Great Lakes Carbon Corporation's Mining and Mineral Products Division. The No Agua deposit is one of the world's largest known deposits of uniform commercial-grade perlite.

To utilize this deposit, a new crushing and sizing plant is now being erected at the site. Upon scheduled completion in June, it will be the perlite industry's most complete and most modern processing plant for crude perlite, the company said.

Until the new plant goes into operation, the company will process the No Agua perlite ore at its existing crushing and sizing plant in Florence,

Howe Sound to Move Offices

The Howe Sound Co. has decided to move its general offices from New York to Salt Lake City. The company announced that it would move its offices by the end of the year (1957) to its new research laboratory facilities in Salt Lake City.

Wyoming U-Mill Sought

Federal Uranium Corp. has asked the Atomic Energy Commission for authority to construct a 500-tpd uranium mill in the Gas Hills area of Wyoming at a cost of \$4,000,000. The request brings to six the number of applications for new mills or expansion of existing mills in Wyoming.

The new request was filed in the face of AEC statements that existing facilities appear sufficient to supply all of the nation's needs.

Large Steel Company uses AKINS COAL CLASSIFIERS



Six - 66" Akins simplex, double pitch coal classifiers were installed four years ago in this coal washing plant. Each classifier rakes 60 to 80 tons per hour of minus 1/4" product and overflows 0 to 20 tons per hour of minus 20 mesh fines. Efficient Akins classifier dewatering resulted in only 18% moisture in the rake product.

Special, Big Capacity Units

The extremely high capacity and dewatering efficiency of these Akins Coal Classifiers was achieved by a unique modification, developed from the use of Akins Heavy-Media Densifiers in heavy-media cleaning circuits.

This large steel company has purchased for its various coal, iron ore, and fluorspar divisions 34 AKINS Classifiers, Heavy-Media Separators, and Densifiers.

SPECIFY AKINS

The Original Spiral Classifier, and the Only Spiral Heavy-Media Separator

COLORADO IRON WORKS CO.

3800 Race Street . Denver, Colorado

AKINS CLASSIFIERS . SKINNER ROASTERS . LOWDEN DRYERS

Sales Agents and Licensed Manufacturers in Foreign Countries

A SUBSIDIARY OF THE MINE & SMELTER SUPPLY CO.

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Dow Buys Chemical Plant

Announcement was made recently of the purchase of the Government magnesium production facilities at Freeport, Tex., by the Dow Chemical Co. The plant is reported to have

cost the company \$20,700,000. The plant was operated during World War II. Closed in 1945, it was reopened in April 1951 because of the Korean War. Dow operated it for the Government through 1953. Since then Dow has had the plant under lease.

Cleaning Plant Nears Completion

Work is nearing completion on the first phase of an extensive improvement program at the Utah coal properties of Columbia-Geneva Steel Division of U. S. Steel Corp.

A coal cleaning plant near Wellington, Carbon County, is expected to be completed in mid-1958. It has a rated capacity of 600 tph of coal and will reduce the ash and sulphur content of the coal for more efficient use in the blast furnaces at the corporation's Geneva works. Located on a 1500-acre site, the plant will process all the coal mined in the firm's Utah and Colorado properties.

A new general office building for the coal mines and quarries division was completed at Dragerton recently. The 40 by 172-ft structure was designed by American Bridge Division of U. S. Steel which is placing the framework for the coal cleaning plant. Each office has individual automatic temperature controls and the building is air conditioned.

At the Columbia coal mine, an 8700-ft rock tunnel is half completed. It is 9 ft high and 13 ft wide and will intersect the coal seam at a point 5000 ft down the pitch from the coal outcrop.

Arizona's Natural Resources

Three thousand copies of an up-to-date bulletin on "Arizona's Natural Resources" are available for free distribution to interested parties, industries and universities, according to a recent announcement by ARC Laboratories, division of Arizona Research Consultants, Inc., 917 W. Hatcher Rd., Phoenix. Requests for copies may be sent to this laboratory or to the publishing agency, the Arizona Development Board, 1521 West Jefferson St., Phoenix. The report considers most of the important natural resources which are known at the present time.

Australian Bauxite Mine Planned

The Queensland State Cabinet has approved a draft agreement for a British-Australian zinc syndicate to mine bauxite at Cape York peninsula, the northern-most tip of Australia.

The agreement provides for a township, harbor and initial treatment works to be built at Weipa, on the peninsula's west coast. Under the pact, the company would produce aluminum at Cape York site. This

would require a town of 6000 persons at Weipa. The zinc group would obtain rights to more than 2000 square miles.

Canadian and American companies also are prospecting in the area.

Texas Aluminum Plant Expands

The first half of a multimillion-dollar expansion program of the Reynolds Metals Co. bauxite ore refining plant at Corpus Christi, Texas, has been completed and the additional facility placed in operation. Ralph S. Sherwin, Jr., plant manager and for whose father the plant has been named, said the 30 million dollar addition has enabled the plant to increase production of alumina from 1000 tpd to 1500 tpd.

Work on another 16 million dollar project which will increase production to 2000 tpd is expected to be completed in October 1958, Sherwin added.

Kaiser Secures Bauxite Concessions

Concessions for the exploration and mining of bauxite in Panama were granted recently to the Kaiser Aluminum & Chemical Corp. by the Panama government. They were the first such concessions granted.

The contract gives a subsidiary company, the Kaiser Exploration Co., exclusive exploration and mining rights in a large area of western Panama near the Costa Rican border.

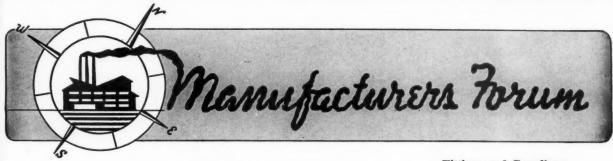
Uranium Mining Report Published

The latest technological advances in uranium mining methods of one of the country's largest independent uranium mining operations, Continental Materials, Inc., were highlighted by the U. S. Bureau of Mines in a technical report recently published. The report describes the mining operations of Continental's No. 1 mine in San Juan County, Utah, where 12 men produce 1500 tons of vanadium-bearing uranium ore a month.

Among the phases of Continental's mining techniques reviewed in this report are the method of blending ore from two different orebodies to keep the grade of shipments at a profitable level, use of diesel-powered trackless mining and haulage units in the underground operations, analyses of mine air to guard against radioactive gases, new roof support methods, and use of different types of drills and explosives for varying rock formations.

Equipment used by Continental in this mine is listed, and a breakdown of the cost per ton of ore during a six-month period is detailed in both dollars and man hours. A copy of report, I. C. 7801, is available from the Bureau of Mines, Pittsburgh, Pa.





Screening Plants



TWO PORTABLE AGGREGATE screening plants, said to be designed for a high rate of production from any suitable materials, have been announced.

Designated models No. 366 and No. 488, the plants consist of a single-deck buzzer screen and reciprocating plate feeder permanently mounted on a lattice frame conveyor installed on a hydraulic cradle truck. Model 366 is equipped with a 3 by 6 ft screen while the screen on model 488 is 4 by 8 ft. Feeder and conveyor are match-

ing.

On both models, the screen is pivotmounted on the delivery end of the conveyor, allowing it to be swung to operating position or to be folded under the conveyor for transport. Hydraulic raising and lowering of the conveyor further simplifies set-up and operation, according to the manufacturer.

For further details, write for Bulletin 460 to Pioneer Engineering, Division of Poor & Co., Inc., Minneapolis 14, Minn.

Fittings and Couplings

A LINE OF FULL-FLOW fittings and three styles of couplings—for use in the recently announced Vic-Easy method of joining lightweight, rolled-groove pipe and tubing—are available from Victaulic Company of America, Elizabeth, N. J.

The line is said to include full-flow elbows, tees, reducing tees, reducers, etc., of every style, for use with either lightweight steel or aluminum pipe with rolled-groove ends. Adapter nipples and other adapter units for connecting grooved-end piping to threaded, flanged or welded outlets are also available.

All fittings are interchangeable and can be installed with any of the three styles of Victaulic couplings—standard, lightweight or snap-joint.

Inquiries about new equipment appearing in Manufacturers Forum are welcomed.

For additional information on any piece of equipment in this section write directly to the manufacturer, or to Mining Congress Journal with name of item and date of issue in which it appeared.

Glazing Strip

FOR BUILDING OF PARTITIONS with either clear or opaque panels, a glazing strip has been announced by Handy Angle Div., Lug-All Co., 355 Lancaster Ave., Haverford 15, Pa. It permits the incorporation of panels of clear or diffused glass, clear, diffused or opaque plastics, and hardboard into various slotted angle structures.

Made of cold rolled steel, Handy Angle glazing strip is available with either single or double sides. Rubber inserts are included to assure a tight, safe fit, according to the manufacturer, and the glazing strip is fastened to Handy Angle members with square necked bolts having mushroom heads. All parts are reportedly cleaned by a diphase process, rust-proofed with an aluminum etching primer and finished with polychromatic lacquer.

Rotary Compressor



A 125 CFM "AUTO-AIR" (truck-mounted) rotary compressor, the Davey Hydrovane Model 125RA is driven direct from the truck engine through a Davey P-80 power take-off. The Auto-Air can be mounted directly on the truck chassis or on a platform

base, and is said to be adaptable to any type of truck body. The compressor is of the Davey multi-stage rotary type with a single free-floating rotor. For complete data, write Davey Compressor Co., Kent, Ohio, and ask for Bulletin M-131.

Weighing Cars While Coupled and in Motion

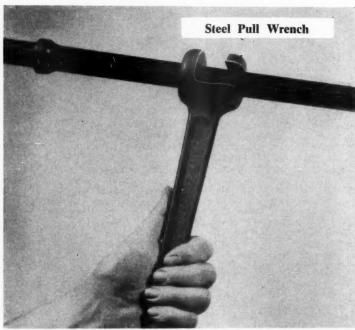
TOF RAILROAD and business executives recently witnessed the initial demonstration of a method of weighing railroad freight cars without stopping or uncoupling them.

This new system, called rail-weight, will increase the speed of rail shipments by 7.4 percent, add the equivalent of 25,000 new railroad cars, detect



dangerous loading and increase the railroads' earnings in excess of a quarter of a billion dollars annually, according to the International Railroads' Weighing Corp. of Indianapolis, Ind., which developed the method with the cooperation of the Monon Railroad in its South Hammond Yard.

Railweight weighs the cars individually while the whole train runs over the scale. The key to the system is a set of specially designed rails at the approach to a standard scale which eliminates the bind between car couplers. Heretofore weighing cars while coupled and in motion has been impossible, the corporation said, because of the transfer of weight between cars through the bound couplers which made one car weigh heavy while the other weighed light.



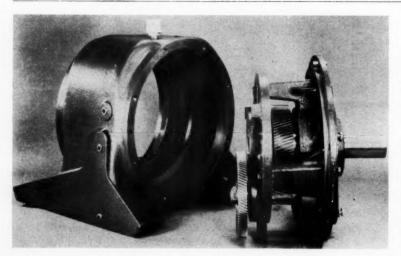
DESIGNED FOR USE WITH 7/8-IN. HEXAGONAL STEELS, this steel pull wrench is said to free stuck drill steels thanks to a double-surface locking principle which makes it possible to pull and twist the "frozen" steel loose at the same time. It is available from Atlas Copco Eastern, Inc., of Paterson, N. J., and Atlas Copco Pacific, Inc., San Carlos, Calif.

Preventing Loss of Mineral Fines

FOR FORMING PROTECTIVE CRUSTS over mineral and coal fines, either in stockpiles or in open railroad cars, the Mining Chemicals Department of American Cyanamid Co., New York 20, N. Y., is offering a new product. Diluted with water and sprayed on the surface of the coal or ore, it sets up to form a tough crust which reportedly prevents wind and rain erosion. Samples of film-forming Reagent S-3152 and technical notes on its use are available on request.

Slurry Pump

THIS MEDIUM-RANGE, high speed slurry pump—known as the Type BA—has been introduced for handling suspensions of sand, coal, crystals, silt, sludge, lime or chemical process slurries. Built in 1, 1½, 2, 3 and 4 in. sizes, the BA pump is available in cast iron, Ni-hard or stainless steel, and has a renewable suction liner and semi-open impeller. Further information may be obtained by writing for Bulletin 188 to Morris Machine Works, Baldwinsville, N. Y.



Gear Line

A LINE OF HELICAL-GEAR, speed-reducing apparatus, called Moduline, has been announced by Westinghouse Electric Corp., Pittsburgh, Pa. Basic subassemblies and accessories are combined to make any helical-gear drive configuration.

The heart of the gear line is a double-reduction cage with a fixed five to one set of low-speed gears. Change gears are mounted on rolled spline shafts so that they reportedly can be mounted or replaced with common hand tools. Gears in the triple and quadruple reduction subassemblies are also spline mounted. A total of seven unit sizes to 30 hp are available with ratios of 5 to 1 to 625 to 1.

Election of three vice-presidents and a secretary by the Allis-Chalmers Manufacturing Co. board of directors, has been announced.

Named vice-presidents were P. F. Bauer, managing director, Allis-Chalmers International; E. J. Mercer, general manager, Construction Machinery Division; and William M. Wallace, general manager, General Products Division.





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Robert L. Halsted has been named general manager of the Industrial Equipment Division of Allis-Chalmers Mfg. Co. He succeeds P. F. Bauer, who was named managing director of Allis-Chalmers Internation, a new operating division. Edward H. Baxa became manager of Allis-Chalmers processing machinery department, succeeding Halsted.

R. E. Young has been named to the newly created position of special representative for the Electric Excavator Division of Harnischfeger Corp. He will concentrate on expanding markets for his company's line of large electric shovels.

Announcement was made recently of a plan for the purchase of Union Wire Rope Corp. of Kansas City by the Armco Steel Corp. of Middletown, Ohio. Subject to approval by the shareholders of Union Wire Rope, that company became a subsidiary of Armco and will retain its name and be reorganized.

Allan H. Newbury has joined the Long Co. of Oak Hill, W. Va. as controller. Prior to his new affiliation, Newbury spent 12 years in the mining machinery manufacturing business with the Goodman Mfg. Co.

The Ogden Corp. recently acquired the Eimco Corp. and the American Foundry & Machine Co., both of Salt Lake City, Utah.

The appointment of Paul C. Manlev as sales manager for the Cardox Corp. Mining Division and William R. Hennessey as assistant sales manager has been announced. Both will headquarter in Chicago.

On October 31 property and equipment of the Humphreys Investment Co. applicable to its Engineering Division, together with certain other property, was transferred to Humphreys Engineering Co., formed for the purpose of carrying on the business heretofore conducted by the Engineering Division. The change applies principally to the manufacture and distribution of the Humphreys spiral concentrators.

William W. Gould has been named Chicago district manager of Edison Storage Battery Division; Elmer W. Ahlstrom has been appointed Cleveland district manager, while Jerome V. Huth becomes manager of the Export Department in New York.

Floyd R. Anderson, chief metallurgist of the Denver Division of the Gardner-Denver Co., has been named assistant manager of the division. He has been succeeded as chief metallurgist by Richard F. Schaffer.

Proposed plans for the merger of Dresser Industries, Inc., Dallas, and Gardner-Denver Co., Quincy, Ill., have been abandoned. Representatives of the two companies revealed that a detailed study showed that the intended combination could not be effected on a basis that meets the anticipated benefits and objectives.

CATALOGS & BULLETINS

RUBBER-LINED CENTRIFUGAL PUMPS. Allen-Sherman-Hoff Pumps Co., 259 East Lancaster Ave., Wynnewood, Pa. Two four-page folders colorfully present the interchangeable splitshell Hydroseal and Centriseal slurry pumps, all parts of which are identical excent their nubber impellars and agrica. pumps, all parts of which are identical except their rubber impellers and engineside shell half-liners. Brochure No. 457 entitled, "Hydroseal Rubber-Lined Pumps," describes how these pumps for moving abrasive materials use a controlled flow of clear liquid into the stuffing box under pressure to prevent shaft-sleeve erosion and gland leakage. Centriseal rubber-lined pumps, described in Brochure No. 557, is said to deliver the seal rubber-lined pumps, described in Brochure No. 557, is said to deliver the pulp undiluted because it operates without sealing water.

SLIDING TYPE BELT CONVEYORS. Carpco Manufacturing, Inc., Jacksonville 6, Fla. Design, specifications and operating details covering the Carpco sliding type belt conveyors are included in Bulletin BCB-101. Full descriptions of various construction features are given along with capacities of 50, 100 and 150 lb per cu ft materials which can be handled by models BC68 and BC1214. The conveyor is said to be designed for a broad range of materials which are either wet or dry, lumpy or granular, light or heavy, smooth or abrasive.

WALL CHART OF CONVERSION FACTORS. Precision Equipment Co., 4411 E. Ravenswood Ave., Chicago 40. Ill. This reference table for engineers and other executives includes such company conversions as includes to continuous mon conversions as inches to centimeters or watts to horsepower as well as many conversions that are difficult to locate in reference manuals.

WIRE AND CABLE. Rome Cable Corp., Rome, N. Y. The second edition of the Rome Cable Manual of Technical Information, a 393 page book of the wire and cable industry first published ten years ago, is divided into eight sections:

(1) Wire and Cable Technical Tables, (2) Wire and Power Cable Engineering Calculations and Data, (3) Communication Frequency Data and Calculations, (4) National Electrical Code Data, (5) Properties of Metals, (6) General Technical Information, (7) Conversion Tables and (8) Cable Installation Practices. Revision of the manual keeps pace with technical advances and changes in wires and cables since 1947, the date of the first edition. Also reflected are changes in industry standards, regulations and practices in the last decade. All sales (It's \$4.50 a copy, plus 12 cents postage) will be handled directly from Rome.

SOLENOID VALVES AND ELECTROMAGNETIC CONTROL. Automatic Switch Co., Florham Park, N. J. Literature provides condensed information on the complete product line of ASCO solenoid valves and electromagnetic control. Categories covered under solenoid valves include two-way, three-way, fourway, corrosion resistant, manual reset and special purpose valves. Electromagnetic control categories include automatic transfer switches, remote control switches, contactors, relays, solenoids and electric plant controls.

TAKE-IT-AWAY. Macchyte Co., Public Relations Dept., Kenosha, Wis. An educational picture, this film traces the history of slings and shows various types in action. The film explains how the rated capacity of a sling will vary due to stresses caused by the various methods of applying the sling to the load. Film is a 16-mm black and white motion picture production with sound and has a running time of approximately 20 minutes. It is available to safety associations, engineering societies, clubs, manufacturers and industrial groups on a loan basis.

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(Continued from previous page)

TUBE COATING OILS. Sales office, Tubular Products Division, Babcock & Wilcox Co., Beaver Falls, Pa. Warehouse managers, plant managers, buyers and others involved with the procurement, storage and fabrication of welded carbon tubing, will be interested in the information on protective coatings furnished by ERW-TSL No. 3. The bulletin describes the various protective coatings and indicates the conditions under which such coatings will supply the required protection.

ADJUSTABLE-SPEED DRIVE. General Electric Co., Schenectady 5, N. Y. Bulletin GEA-6643 describes General Electric's line of packaged direct-current adjustable speed drives available from 3 through 150 hp, 220, 440, 550 volts, 3 phase a-c 60 cycle. Entitled "Speed Variator," the booklet also includes a Power Unit Data Slide Rule for calculating case dimensions, horsepower, speed range, power unit weight and motor frame size.

EXPLORATION OF ELECTRONIC DATA PROCESSING. Remington Rand Univae, 315 Fourth Ave., New York 10, N. Y. An aid to help top management investigate the electronic computer, its capabilities, operation and applications has been published by Remington Rand Univac Division of Sperry Rand Corp., in a 196-pg manual titled, "A Study for Management—The Univac II Data Automation System." Written entirely from the management point of view, the illustrated manual is said to be the ideal starting point for thorough exploration of electronic data processing. Ask for U1352.

TORQUE CONVERTER DRIVE. Allis-Chalmers Mfg. Co., Buda Division, Milwaukee, Wis. The story of Allis-Chalmers "Power Shift Torque Converter Drive" for fork lift trucks is told in booklet BU-465. Photographs and other illustrations are used to help tell about the operating advantages this drive provides.

ELECTRICAL CABLE. General Cable Corp., 420 Lexington Ave., New York 17, N. Y. Entitled "Safety Mineral Insulated Cable," the brochure describes the merits of this product as well as its electrical and physical properties. The cable is said to offer high heat and water resistance and a small OD in which one or more electrical conductors are insulated with a highly compressed refractory mineral insulation and enclosed in a liquid-tight and gas-tight metallic tube sheathing.

MINING CLIPBOARD. Editor, Mining Clipboard, Gardner-Denver Co., Quincy, Ill. A new publication recently released by Gardner-Denver, the booklet is designed to provide both underground and surface miners with timely tips on better use, care and maintenance of equipment—along with unusual product application stories. It will be published six times a year and is available to interested mining men.

SHEAR-HUB SPROCKET. Industrial Marketers, P. O. Box 28, Ferndale 20, Mich. Bulletin 15 describes stock Tork-Trol Shear-Hub Sprockets. Of all-steel construction, with bronze-bushed sprocket and drill-rod shear pins in hardened bushings, Tork-Trol reportedly will provide protection against overloads on any standard roller or conveyor chain drive.

HIGH - SPEED SYNCHRONOUS MOTORS. General Electric Co., Schenectady 5, N. Y. Features and applications of General Electric's large high-speed synchronous motors, and the company services that go with them, are described in bulletin GEA-6620. Cutaway drawings give an X-ray view of the horizontal and vertical motors of 1500 hp and up.

TANK WEIGHING. A. H. Emery Co., New Canaan, Conn. Bulletin 571 describes the concept of tank weighing as a measurement of tank contents. Covered in the brochure is the use of the Emery Hydraulic Load Cell as the load sensing device in an Emery Weighing System. Combined with various available instrumentation, the Emery Load Cell reportedly can provide indication, recording, printing or controlling of the contents of tanks in the processing industry

EQUIPMENT LUBRICATION. Whitmore Mfg. Co., Cleveland 4, Ohio. This folder to serve the mining, construction and manufacturing industries as a handy reference in determining the correct Whitmore's lubricant to use for specific equipment application and for varying seasonal temperatures describes more than 40 different lubricants.

ROTARY CAR DUMPER. Heyl & Patterson, Inc., 55 Fort Pitt Boulevard, Pittsburgh 22, Pa. This illustrated Brochure 957 describes a rotary car dumper developed by Heyl & Patterson. Capable of handling hopper and gondola cars, the dumper is equipped with two clamps which hold the car secure without the use of counterweights. The unit is said to be so well balanced that it can dump and return a spotted car in one minute with 30-hp drive.

Index to Advertisers

A.C.F. Industries, 13

American Cynamid Company, 4 Explosives Department

Bethlehem Steel, 18

Buda Division, 17 Allis-Chalmers Mfg. Co.

Bucyrus-Erie Co., 15

Cardox Corporation, 20-21

Caterpillar Tractor Co., 19

Colorado Fuel and Iron Corp., 8

Colorado Iron Works Co., 83

Deister Concentrator Co., The, 75

Denver Equipment Company, Inside Front Cover

Euclid Division, Inside Back Cover General Motors Corp.

Flood City Brass & Electric Carbon Co., 77

Greensburg Machine Co., 78

Hendrix Mfg. Co., 68

Jeffrey Mfg. Co., 76

Joy Mfg. Co., 10-11

Kennametal Inc., 22

Lee-Norse Co., 16

LeTourneau-Westinghouse Co., 3, 5, 7

Longyear Co., E. J., 73

Mine Safety Appliances Co., Back Cover

Myers-Whaley Co., 80

National Mine Service Co., 9

Ohio Brass Co., 14

Pattin Mfg. Co., 74

Read, Davis, 73

Roebling's Sons Corp., John A., 12

Timken Roller Bearing Company, 2

U. S. Rubber Company, 6

Woomer, J. W. and Associates, 73

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